THE GLORY OF THE GARDEN

Our England is a garden that is full of stately views,
Of borders, beds and shrubberies and lawns and avenues
With statues on the terraces and peacocks strutting by;
But the Glory of the Garden lies in more than meets the eye.

For where the old thick laurels grow, along the thin red wall,
You'll find the tool- and potting-sheds which are the heart of all,
The cold-frames and the hothouses, the dung-pits and the tanks,
The rollers, carts, and drainpipes, with the barrows and the planks.

And there you'll see the gardeners, the men and 'prentice boys
Told off to do as they are bid and do it without noise;
For, except when seeds are planted and we shout to scare the birds,
The Glory of the Garden it abideth not in words.

And some can pot begonias and some can bud a rose,
And some are hardly fit to trust with anything that grows;
But they can roll and trim the lawns and sift the sand and loam
For the Glory of the Garden occupieth all who come.

Our England is a garden and such gardens are not made
By singing:—"Oh, how beautiful," and sitting in the shade
While better men than we go out and start their working lives
At grubbing weeds from gravel paths with broken dinner knives.

There's not a pair of legs so thin, there's not a head so thick,
There's not a hand so weak and white, nor yet a heart so sick,
But it can find some needful job that's crying to be done
For the Glory of the Garden glorifieth every one.

Then seek your job with thankfulness and work till further orders,
If it's only netting strawberries or killing slugs on borders,
And when your back stops aching and your hands begin to harden
You will find yourself a partner in the Glory of the Garden.

Oh! Adam was a gardener, and God who made him sees
That half a proper gardener's work is done upon his knees.
So when your work is finished, you can wash your hands and pray
For the Glory of the Garden that it may not pass away.

—RUDYARD KIPLING.

GARDENING, AN ANCIENT ACTIVITY

Extracts from article in *Gardeners' Chronicle* (New York.)

. . . In architecture, plants and flowers have furnished the prototypes for many historical styles of ornamentation. I need only to remind you of the Acanthus of the Greeks; the Lotus, so typical of ancient Egypt and no less sacred in the architectural ideas of the Chinese and Hindoos; the Rose in the Middle Ages (the Rose Window); the symbolic trefoil of ecclesiastical ornamentation. I can do no more than hint at the vast part which flowers and plants have played and are still playing in the arts and crafts of the world.

* * * * * * * * * * * *

But they had yet another influence, they led man into the primitive paths of science. He had learned by experience that while certain plants and flowers afforded him relief from physical inconvenience or pain, others were very harmful in their effects. So he studied their structure and nature more closely, noted their characteristic efficacy or injury. Here was the beginning of the botanical and medicinal sciences.

. . . In the craft of gardening, we probably have the most ancient domestic activity of man. The Garden of Eden at once suggests itself. Among the Seven Wonders of the Ancient World were the Hanging Gardens of Babylon, created to please Semiramis, the queen. In fact, many ancient fragments of literature give proof of the esteem of and care devoted to gardens, the pride in their extent and beauty.

Never has the art of gardening been held in greater honor than it was among the Egyptians two or three thousand years ago. In Egypt, the garden was of far greater importance than with us at the present time. . . . Funeral obsequies were celebrated in the garden of the deceased, his grave was adorned with a miniature reproduction of it. . . . The guest was given his first welcome in the garden; he received a flower which he must hold in his hand throughout his stay. Besides the sacred Lotus, ancient Egypt cultivated Chrysanthemums, Centaureas, Poppies, Convolvulus, Thistles—an improved variety of which, by the way, is a favorite in certain garden schemes today, proving the old adage "There is nothing new under the sun".

It is very probable that the Greeks and Romans learned their horticultural art in Egypt. We have abundant allusions in the classic writings to the skill and care exercised in procuring a varied supply of flowers for ceremonial use. The temples were decked with them. They were used as votive offerings to the gods. Triumphal processions passed over flower strewn streets, while choice flowers rained down on the participants. Indeed, the Floralia was their own special festivity in Spring, of which May Day with its garlands and rustic merry-making is a modern survival. At Roman feasts guests wore garlands of flowers tied with Linden bark to prevent intoxication. The banquet hall, the dishes, the cups, the waiters,

all were adorned with flowers. And as symbolic meanings were attached to the different flowers and plants, it was a nice art to use just the right combinations demanded by the occasion and the social importance of the guests. Garlands, too, were tossed to the actors on the stage; they were the badges of victory.

Among the Orientals the art of gardening was also well developed and no less esteemed. Of Persian garden art, ancient rugs and their descriptions give us a good idea. There is a Chinese poem of the tenth century devoted to the description of a wonderful garden, giving proof of the antiquity of that unique art for which China is famous even today.

That the art of garden planning and planting was highly developed in Italy is not strange. It was the direct heritage of Roman horticulture. . . .

Many historic gardens have existed in China, and a point worthy of notice is, that a couple of hundred years before the Christian Era, the Emperor Wu of Han created an immense pleasaunce called Shang Lin, or Royal Park, where he desired to spend happy days and hours. However, public opinion, always so powerful in China, frowned upon this monopolization of arable land and he was obliged to give up his park and allow the farmers to put it under cultivation again. This incident is an example of the fact that the Chinese have never permitted an individual, no matter how high his rank, to absorb too much ground for his private use. Gardens, though full of hills, lakes, valleys and vistas, in reality occupy a comparatively small space, and extensive private pleasure grounds, with large lawns, wide herbaceous borders, and elaborate parterres such as are common in the West, would not be tolerated for a moment. A Chinese has always been obliged to confine his garden within a small space and has never been allowed to seriously interfere with the most important business of life—that is agriculture. In this connection it may be recalled that, according to the Chinese division, the four Classes of Society are: first, Scholars; second, Agriculturists; third, Labourers; fourth, Traders. Soldiers, sailors, and other classes whom we honour are not considered as worthy of mention in the social system.

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There are many treatises in Chinese on the growing of flowers. Early in the eleventh century, soon after William the Conqueror invaded Britain, a certain Liu Ming wrote a work on chrysanthemums, dividing these flowers into thirty-five varieties; and a writer of the Yuan dynasty, which flourished about the time of Edward I, divided the *moutan* peony into thirty-nine classes.—Florence Ayscough. In *A Chinese Mirror.*

There are over two hundred natural families of flowering plants with seventy-six hundred general and well over one hundred thousand species

and varieties. The species of the flowerless plants, which include microscopic fungi, lichens, ferns, mosses, and mushrooms, are more numerous than the flowering plants. . . .

The Rose family (Rosacea) may be called the fruit family, as in this group are apples, pears, quinces, plums, apricots, almonds, cherries, raspberries. Prunus includes the stone fruits with well over one hundred species in many parts of the world. Pyrus, including apples, pears, Mountain Ash, has more than forty species. Of Roses, more than two hundred fifty species have been described at various times. This family also embraces strawberries and Spireas, and in all totals some one thousand species and varieties.

Three hundred fifty and more species of Begonias are known to botanists. By far the largest order is the Composite group or Sunflower family, containing nearly eight hundred genera with ten thousand species. Very few of the species furnish esculent parts, the chief being lettuce, chicory, artichoke, and salsify. The family comprises great numbers of ornamental plants, the most prominent of whch is the Chrysanthemum. . . .

The Palm family (Palmae) includes eleven hundred fifty species, some of which produce edible fruits, the best known being dates and coconuts.

The Grass family (Graminea) is the most important of all, with wheat, oats, Indian corn, sugar cane, barley, and the like among its members. There are over three thousand species to this family.

—*Gardeners' Chronicle* (New York.)

An ideal man of science is a man of his own time and rather a harbinger of the coming age than a representative of the bygone ones. He is thoroughly human, and therefore never exclusively engrossed by his own special work, though he gives it his days and sometimes his nights. He is eager for every noble cause, responsive to the great calls of his age, and endowed with a beautifully furnished mind. He is no stranger to the invaluable treasures which the ancients bequeathed to us. Their poetry, their philosophy appeal to him. He finds therein a matchless refreshment, which makes him the more keen-witted, the more clear-sighted for his own investigations.

L. Levy-Bruhl.

The great end of life is not knowledge but action.—Thomas Huxley.

OBSERVATIONS ON RANGE CATTLE AT THE HACIENDA DEL ROSARIO, CAINTA, RIZAL[1]

VALENTE VILLEGAS AND FELIX B. SARAO
Of the Department of Animal Husbandry

From May 9 to 13, 1927, the writers were in charge of laboratory practice performed by students of a cattle husbandry class of the College of Agriculture, University of the Philippines, at the Hacienda del Rosario, Cainta, Rizal. The work consisted of roping and throwing down animals for branding, and the castration of bulls unsuitable for breeding purposes. This work gave an opportunity for making observations on the cattle of the ranch, which in the opinion of the writers typify the class of animals found on many of the ranches in the Philippines.

There were 152 cattle included in this study. Studies were made as to their sex, color, breeding, age, height, and conformation. They were selected principally on the bases of age, size, and conformation, and then classified according to their suitability for breeding, work, and slaughter.

All the animals were pastured on an area of about 400 hectares, being transferred from one section to another for rotation purposes. The pastures are generally very well drained and a creek of clear flowing water crosses the ranch to furnish sufficient clean water throughout the whole year. On the lowlands, amor seco (*Andropogon aciculatus* Retz.) forms the main forage supply, while on the hillsides, cogon (*Imperata cylindrica* var. *koenigii* (Retz.) Benth. ex Pilger) and talahib (*Saccharum spontaneum* L.) prevail. Trees of various species grow on the pastures and furnish shade for the cattle at midday.

As part of the improvement work being developed by Doctor Tubangui, two bulls from the College of Agriculture, University of the Philippines, were acquired for breeding purposes. One of these was of ¾ Nellore-¼ Native breeding which at four years of age weighed 460 kilograms and was 134 centimeters high. The other bull was of ½ Hereford-½ Native breeding, which at four years and nine months of age weighed 440 kilograms and measured 125 centimeters in height. Besides these two, a grade Nellore bull, 125 centimeters in height, was used for grading up purposes. Twenty-one other bulls which were small or otherwise poor in conformation were castrated. The influence of the three selected bulls will begin to show in the 1928 calf crop, and thereafter.

[1] Experiment Station contribution No. 468. Received for publication October 1, 1927.
The writers are indebted to Dr. M. A. Tubangui, in charge of the ranch, through whose courtesy the data presented herewith were secured.

During the rainy season when pasturage is plentiful the herd has the freedom of the range in the daytime and is corralled at night to prevent animals straying away. In the dry season when the grass is short and poor the herd is confined at night only twice a week. Salt is given in the corral in the evening. Two men take charge of herding the animals and doing other work on the ranch, such as salting, reporting births, accidents, and diseases in the herd, and catching the animals for the market or for treatment, repairing the fences and corrals, etc.

SEX

At the time of this study eighty-five of the animals, representing 55.9 per cent, were females, of which nine were calves. There were 24 bulls, or 15.8 per cent, 21 of which were calves, and three were mature breeding bulls, the ones previously mentioned. The remaining 43 animals, or 28.3 per cent were steers, 21 of which were castrated at the time this study was made. (See table 1.)

COLOR

Seven colors were shown by the animals; namely, black, red, white, fawn, yellow, roan, and red and white. Black predominated, 46 or 30.3 per cent of the animals being of this color. The next predominating color was red, there being 39 or 25.6 per cent. There were 30 or 19.7 per cent white animals; 24 or 15.8 per cent fawn and 11 or 7.2 per cent yellow. Only one roan animal was in the herd and one red and white. (See table 1.)

BREEDING

The majority of the animals were grade Indian, there being 145 or 95.4 per cent. From the looks of the animals it was apparent that the amount of Indian blood in the animals was low although characteristic Indian points were manifest. Only the two grade Indian breeding bulls were of high Indian blood. There were six cows or 3.9 per cent of native breeding, these being old foundation cows of the herd. One grade Hereford bull was used for breeding purposes. (See table 1.)

The age of the animals was determined according to the replacement of the temporary incisors by permanent teeth.[2]

At the time of observation there were 31 calves and the same number of weanlings, constituting in all 40.8 per cent of the animals. There were 21 two-year-olds or 13.8 per cent; 17 three-year-olds or 11.2 per cent; 15 four-year-olds or 8.5 per cent; and 25 medium-aged and old animals, or 16.5 per cent. The latter included those that were over five years of age. (See table 1.) This seeming large number of young stock might indicate a high percentage of breeding ability of the cows, but the writers were informed that a number of cows in good condition had been sold for slaughter.

[2] Pope W. George. 1919. Determining the age of cattle by the teeth. U. S. Dept. Agric. Farmers' Bull. 1066: 4. *Fig. 1–6.*

HEIGHT

As an index of size, height was secured. While the animal was cast down the height was taken by measuring the distance from the top of the withers just behind the hump to the tip of toe. The height of calves was not determined inasmuch as there was no way of telling their approximate age up to two years of age. The medium-aged and old cattle were classified together, assuming that their height is stationary after they are five years old. From table 2, it will be seen that the average height of two-year-olds was 105.4 centimeters. Comparing this with the average for three-year-olds, 107.4 centimeters, it is clear that the three-year-olds were 1.9 per cent taller than the two-year-olds. The four-year-olds averaged 109.8 centimeters in height, or 4.2 per cent taller than the two-year-olds. Cattle of five years of age were, on the average, 110.7 centimeters in height, or 5.0 per cent taller than the two-year-olds. In the case of medium-aged and old animals the average height was 110 centimeters or 4.4 per cent taller than the two-year-olds, but 0.7 centimeters lower than the average for five-year-olds. The smaller size shown by medium-aged and old animals was probably due to the presence of several native cows in the herd and to the seemingly lower concentration of Indian blood among the rest of the animals.

Comparing the heights of these animals with those of the College of Agriculture (see table 3), it may be seen that the two-year-olds of the College had an average height of 115.2 centimeters or 9.3 per cent taller than those of the ranch. The College three-year-olds measured on an average 124.1 centimeters or 15.5 per cent taller. The four-year-olds, although only three animals, averaged 124.7 centimeters or 13.6 per cent taller. The outstanding superiority in height of the animals at the College of Agriculture is due to the use of better stock, particularly bulls, and the higher concentration of improved blood in the animals.

CLASSIFICATION

According to table 4, 44.7 per cent of the herd or 68, represented breeding cows. This did not include the female calves, or 19.7 per cent, which were too young to be classified. There were 44 steers or 28.9 per cent, of which 21 or 13.8 per cent of the total showed sufficient merit to be retained and raised as work stock, while the remaining 23 or 15.1 per cent were poor and suitable only for slaughtering purposes. Seven cows or 4.6 per cent were classified as butcher stock because of unusual small size. For breeding purposes three bulls or two per cent were left in the herd.

SUMMARY

This study includes 152 animals representing the type of cattle generally seen on ranches in the Islands.

Ample pasturage is provided for the animals during the great part of the year, shortage of forage being experienced for a brief period during the hottest month of summer. The rotation of pastures increases the carrying capacity. Good water supply is obtained from a creek. The animals are salted at regular intervals.

The majority of the animals were females. There was a good number of marketable steers suitable for slaughter and for work. Of the bulls, three were kept for breeding purposes while the rest were calves too young to be castrated.

The colors represented were black, red, white, fawn, yellow, roan, and red and white. About one-third were black and about one-fourth were red.

Over 95 per cent of the herd were Indian grades. One bull was a Hereford grade bull used for breeding purposes. The rest were old native foundation cows.

Young animals up to five years of age constituted about 85 per cent of the herd, the rest being older cattle. Over 40 per cent were calves and weanlings.

The size of the animals as shown by height was low compared with grade Nellores at the College of Agriculture. This smaller size was due mainly to better bulls being used in the College and the higher composition of improved blood.

Based on size, age, and conformation, there were about 45 per cent of breeding cows, about 20 per cent of butcher stock, about 14 per cent of work steers and about 20 per cent of nursing calves. Two per cent (3) were bulls kept for breeding purposes.

TABLE 1

Showing the distribution of sex, color, breeding, and age among the animals

DISTRIBUTION	NUMBER	PER CENT
Sex:		
Cows	85	55.9
Steers	43	28.3
Bulls	24	15.8
Color:		
Black	46	30.3
Red	39	25.6
White	30	19.7
Fawn	24	15.8
Yellow	11	7.2
Roan	1	0.7
Red and white	1	0.7
Breeding:		
Indian grade	145	95.4
Native	6	3.9
Hereford grade	1	0.7
Age:		
Calves	31	20.4
Weanlings	31	20.4
Medium-aged and old animals	25	16.5
Two-year-olds	21	13.8
Three-year-olds	17	11.2
Four-year-olds	14	9.2
Five-year-olds	13	8.5

TABLE 2

Showing the average height of cattle of different ages at the Hacienda del Rosario

2 YEAR-OLDS		3 YEAR-OLDS		4 YEAR-OLDS		5 YEAR-OLDS		MEDIUM-AGED AND OLD ANIMALS	
Brand No.	Height	Brand No.	Height	Brand No.	Height	Brand No.	Height	Brand No.	Height
	cm.		*cm.*		*cm.*		*cm.*		*cm.*
31	101	35	120	29	100	3	108	21	106
33	96	37	102	32	115	40	108	27	109
36	105	49	107	34	112	41	120	30	116
38	101	5	106	48	96	46	110	58	108
39	100	64	96	61	117	55	104	69	113
42	106	65	113	73	106	59	114	70	109
43	107	67	107	78	112	62	110	71	111
44	112	81	106	91	114	74	109	75	114
45	100	87	112	96	113	88	109	76	116
51	104	94	109	100	113	113	108	77	111
54	109	98	101	112	111	116	121	80	113
57	104	107	107	123	113	126	108	84	104
68	109	115	113	124	106			85	110
83	111	119	106					86	104
95	105	122	106					89	112
97	112	125	108					90	111
99	104							103	105
102	116							108	108
109	104							114	104
110	104							117	115
111	104							118	114
								120	111
								121	106
Average.	105.4		107.4		109.8		110.7		110

TABLE 3

Showing the average height of cattle of different ages at the College of Agriculture

NAME	2 YEARS OLD	3 YEARS OLD	4 YEARS OLD
	cm.	*cm.*	*cm.*
1/2 Nellore—1/2 Native			
Active	108.0	120.5	123.0
Aladdin	113.5	——	——
Virginia	110.0	——	——
Alice	109.0	——	——
Dulcinea	110.0	——	——
1/2 Hereford—1/4 Nellore—1/4 Native			
Elisa	116.5	116.5	116.5
Loyalty	118.0	124.5	——
Shine	111.0	113.5	——
Priscilla	113.5	——	——
Evangeline	112.0	——	——
3/4 Nellore—1/4 Native			
Victor	123.0	134.5	134.5
Prospect's Lad	116.5	118.0	——
Juliet	111.5	——	——
1/2 Nellore—1/2 Hereford			
November 5th	123.0	130.5	——
November 8th	123.0	130.0	——
Provincial Fair	119.0	129.0	——
Romeo	121.0		
Average	115.2	124.1	124.7

TABLE 4

Showing the classification of animals at the Hacienda del Rosario

CLASS	NUMBER	PER CENT
Breeding bulls	3	2.0
Breeding cows	68	44.7
Work steers	21	13.8
Butcher cows	7	4.6
Butcher steers	23	15.1
Nursing calves	30	19.7
Total	152	99.9

THE SUGAR CANE LEAF-HOPPER, PERKINSIELLA VASTATRIX BREDDIN (DELPHACIDAE, HOMOPTERA)[1]

CORNELIO M. URBINO

WITH TWO PLATES AND THREE CHARTS

INTRODUCTION

The sugar cane leaf-hopper, *Perkinsiella vastatrix* Breddin, is one of the relatively important pests of sugar cane in the Philippines. On account of the semigregarious habits of both the nymphs and the adults, their work is often followed by serious injury during months when they are abundant. The weakening of the plants, resulting from direct effect of feeding, is evidently frequently followed by infection through the punctures by pathogenic micro-organisms. The wounds opened in the leaf midribs (pl. 2) and leaf sheaths (pl. 2), and even in stems (pl. 2), by the ovipositor as the female lays her eggs are not infrequently attended by similar complications.

At the present time, the pest seems to be adequately controlled through the greater part of the year by natural enemies, especially egg parasites, so that apparently it presents no real immediate problem to sugar cane culture in the Philippines. Yet the occasional outbreaks in large numbers in Los Baños and other localities tend to show that the existing natural check does not upset the balance of Nature heavily enough. The menace hangs, like the sword of Damocles, with the suspending thin hair of natural enemies temporarily keeping it from its destructive work.

Review of literature

Breddin (1896) published the earliest recognizable record of this species under the name *Dicranotropis vastatrix* n. sp. His description was based on Javanese specimens collected by Doctor Krueger, on whose authority Breddin noted that the insect was "auf Java sehr verbreitet; lebt verborgen hinter den Blattscheiden und sticht diese und den Blattnerv, worin auch die Eier abgelegt werden an." In addition to sugar cane, sorghum was mentioned as a host. The insect was removed from *Dicranotropis* and transferred to *Perkinsiella* by Kirkaldy (1907).

A number of Dutch and other European entomologists working in Java published accounts on *P. vastatrix*. These papers were mostly short, general descriptions of egg, nymphs, adults, and work on the sugar cane.

[1] Thesis presented for graduation, 1927, with the degree of Bachelor of Agriculture from the College of Agriculture No. 257; Experiment Station contribution No. 468. Prepared in the Department of Entomology under the direction of Associate Professor Leopoldo B. Uichanco.

Among these authors were Zehntner (1897), Krueger (1899), Van Deventer (1906), and Dammerman (1919).

Mention of the occurrence of this species in Japan and in Formosa was confined to a short fragmentary statement in the *Bericht uber das zoölogische Museum in Rechnungsjahr 1914*, 8: 133. This same unsatisfactory condition holds true in the Philippines, where among others, Muir (1916) merely recorded the insect in a systematic paper on Delphacidae, and Copeland (1916) listed it among sugar cane insects. In other countries enumerated under the heading "Geographical Distribution" the situation is not much better. Indeed, so far as the writer knows, there is at present no publication which even approaches a fairly comprehensive account of the life history, habits, and other biological phenomena relative to this important pest.

Geographical distribution, with remarks on host plants

A fairly extensive search of the literature indicates the following geographical range of *Perkinsiella vastatrix.*

Oriental Region[2]

Countries	*Authorities*
Federated Malay States	Corbett and Gater (1926)
Java	Breddin (1896)
	Zehntner (1897)
	Krueger (1899)
	Van Deventer (1906)
Celebes	Krueger (1899)
Sunda Isles; Formosa	Matsumura (1914)
Amboina, Ceram, Papua	Muir (1910)
Philippines	

Palaearctic Region

Japan	Matsumura (1914)

It will be seen from the foregoing data that this species is apparently confined to a small portion of the Eastern Hemisphere, specifically the Oriental Region and a small part of the Palaearctic. It is inconceivable that if *Perkinsiella vastatrix* occurred in other regions it would not be recorded, since entomological work has been fairly extensive in many of the countries not included in the present list.

This fact is significant in that it indicates that the species is probably an original component of the Oriental fauna. It is perhaps autochthonous

[2] The classification into geographical regions is based on Wallace, Alfred Russel, 1876. Geographical distribution of animals **1**: 503 p. London.

in the Philippines, in common with the other countries in the Oriental Region, as is further evident from the large number of specific parasites associated with it. It may likewise be presumed that the original host of the insect was some native grass, probably *Saccharum spontaneum* subsp. *indicum* Hack (talahib), later, taking to the sugar cane, which is of prehistoric introduction in the Philippines. Apparently sugar cane subsequently became the preferred host, since in localities where this crop is planted, the talahib for a considerable distance from sugar cane plantations, even in months of greatest abundance of *P. vastatrix*, has been found to be absolutely free from the insect. It is, moreover, worthy of note in this connection that in the course of the present work no grass or other plant species was found to serve as alternative host for *Perkinsiella* in the Philippines. In Java (Breddin, 1896, on the authority of Krueger), sorghum is reported as additional host; and corn in the Federated Malay States (Corbett and Gater, 1926).

Systematic consideration

Perkinsiella vastatrix Breddin[3] belongs to the family Delphacidae, tribe Delphacini (Homoptera). Muir (1916) records six species under this genus in the Philippines, four of which, *bakeri* Muir, (?) *saccharivora* Muir, *lineata* Muir, and the present species, are found on sugar cane. Of these, however, *P. vastatrix* is apparently the only real pest of this crop, the others being too uncommon to be of economic importance.

It is worthy of note that *P. saccharicida*, which is so destructive in the Hawaiian and Javanese cane fields, is either absent or very rare in the Philippines; published reports of Banks (1906) and other authors to the contrary.

Object of the present work

The object of the present work was to study the biology of *Perkinsiella vastatrix* with special reference to control measures suited to Philippine conditions.

Time and place

The work covered a period of approximately one and one-half years, from July, 1925, to January, 1927. Experiments and observations were conducted both in the laboratory and in the cane fields of the College of Agriculture, Los Baños, Laguna. Also, trips were made to the farms in the vicinity of the College campus and elsewhere.

MATERIALS AND METHODS

A number of insectary methods were tried in life history work. The most convenient, and likewise the most satisfactory, method was to use small sugar cane transplanted in pots and introduce nymph or adult hoppers thereon, as the case demanded. Small glass lamp chimneys, covered

[3] Thanks are due to Dean Charles F. Baker for the identification of these specimens.

over the top with cheese cloth, provided adequate breeding cages. Cut leaves were found unsuitable for the present purpose.

Leaves containing egg clusters were collected, cut into suitable lengths and confined in battery jars for rearing first-instar nymphs and egg parasites. The lower ends of the leaves were immersed in vials of water to prevent too rapid drying.

For preservation of insect materials for study, eggs, nymphs, and adults were fixed in water at about 80°C. for ten minutes, then transferred to 80 per cent alcohol, where they were left until used. Some of the specimens were carried through the higher grades of alcohol and finally mounted in balsam. In the case of nymphs and adults, previous maceration in 5 per cent aqueous solution of potassium hydrate was resorted to in order to bring out anatomical details in the exoskeleton. Gage's stain for Coccidae was employed to good advantage.

A series of dry adult specimens on pins was also kept for comparison. Fresh material of all stages was used as check.

EXPERIMENTS AND RESULTS

Descriptions

Egg (*pl. 1, fig. 1*). Length 1.11 millimeters, width 0.22, thickness 0.21. Elongately subcrescentic, conspicuously smaller toward anterior than posterior pole; a cup-shaped, transparent cap fitting closely around anterior end and becoming detached as the young insect hatches; posterior end rounded; concave ventrally and correspondingly convex dorsally; opaque brownish white, with irregular internal red mass showing through anterior end some time prior to hatching. Freshly laid egg delicate; hard and brittle as it grows older.

Adult male (*pl.* 1, *fig.* 7). Length of body (exclusive of appendages) 3.4 millimeters; width 1.3; length of head 0.34; width 1.3; length of antenna 0.34; width 0.93; length of fore wing 4.3; width 1.22; length of hind wing 3.02; width 1.55.

General color of body light yellowish brown, but darker brown on the following parts: anterior portion of head, especially between carinae, pronotum, scutellum, and tarsi. Fuscous as follows: abdominal tergites and sternites, tibial and tarsal spurs, and eyes.

Head vaguely subovate from dorsal aspect, triangular from frontal and lateral; about one-tenth as long as total length of body. Labium subcylindrical, covered with numerous fine hairs, three-segmented, segment I obscure, II subcylindrical, slightly swollen proximally and distally, about four times as long as broad, about five-ninths total length of labium; III elongately subpyriform, about four-fifths as long as II and slightly smaller in diameter, about four times as long as greatest diameter, apex blunt. Mandibular seta subfiliform, abruptly enlarged basally into a broadly subconical process which is twelve times as long as diameter at base, and

five times as broad as main part of seta; slightly swollen into subellipsoidal apex; total length of seta about sixty-five times diameter at base; maxillary seta subfiliform, abruptly enlarged basally into a broad, obliquely subconical process which is about twice as broad as base of mandibular seta, about nine times as long as diameter at base and about eleven times as broad as main part of seta, gradually terminating distally into slightly attenuate, rounded apex. Labium vaguely subtriangular, about one-half as long as labial segment II and about twice as long as broad. Clypeus subtriangular, about twice as long as labrum, about one and one-third times as long as broad. Genae not prominent, with lateral margin nearly confluent with those of clypeus and labrum; subcoextensive with the two latter structures. Ocelli not in evidence. Frons subrectangular, about twice as long as broad, tripartite, with a carina on either side longitudinally midway between mesal depression and margin of eye, meeting into an acute angle at point equidistant from frontoclypeal suture and from anterior margin of head at vertex; a transverse carina midway between anterior margin of vertex and occipital margin, which with the two longitudinal carinae noted above and another short posteromesal, longitudinal carina divide head from dorsal aspect into five subequal, vaguely subcircular, depressed areas. Antenna about five times as long as width of vertex; two short proximal segments, scape and pedicel; sixteen segmented bristle-like terminal clavola. Scape short and stout, slightly enlarged toward distal end, with numerous irregularly arranged spines, interspersed with very minute hairs distally; about twice as long as broad. Pedicel subcylindrical, about one and one-third times as long as broad, slightly swollen at middle, covered with numerous minute hairs, spines, and sensoria, which are arranged in rings, except at base. Basal segment of clavola flask shaped, with a few successive, irregular, almost inconspicuous, ringlike elevations; numerous minute hairs; about one and one-half times as long as broad, about one-fifth as broad as pedicel; more distal segments, except apical, rugulose, gradually increasing successively in length and decreasing in diameter; apical segment about one-third total length of clavola. Eyes irregularly subhemispherical, dark reddish brown, large and prominent.

Thorax about as long as broad, about one-third total length of body. Prothorax abruptly attenuate anteriorly; pronotum subreniform, posterior margin concave, anterior convex, about one-fourth as long as broad, slightly broader than head, tricarinate; carinae subconfluent with those of head. Mesoscutellum tricarinate, about two and one-half times as long and nearly as broad as pronotum, about one and one-third times as long as broad, produced into an acute angle distally. Metathorax slightly shorter and nearly as broad as prothorax, metascutellum about two-thirds as long and one-third as broad as mesoscutellum, about one and one-third as long as broad. Prothoracic leg (pl. 1, fig. 12) covered with numerous hairs and spines. Coxa subcylindrical, slightly incrassate subdistally, covered with numerous minute hairs, sparsely beset with bristles, about two and one-half

times as long as broad; trochantin and trochanter visible as two distinct sclerites. Femur slightly attenuate distally, about as long as coxa, irregularly covered ectally with numerous short bristles; ental depression with linear rows of short bristles on either side at margin; about five times as long as broad. Tibia subcylindrical, slightly incrassate distally, subequal in length to and about three-fourths as broad as femur, about eight times as long as broad, covered with numerous minute bristles arranged in subregular linear rows. Tarsus about one-half as long, and nearly as broad as tibia, three-segmented, covered with numerous bristles; segment I subtrapezoidal, acutely angulate entodistally, about twice as long as broad; II subtrapezoidal, acutely angulate ectoproximally, less so entodistally, about twice as long as broad, and about one and one-third as long and also as broad as I; III subcylindrical, about two and one-half times as long as broad, about as broad as II, acutely angular ectoproximally. Unguis about one and one-fourth as long as breadth at base. Mesothoracic leg (pl. 1, fig. 13) about as long as prothoracic. In characters of parts and relative proportions similar to prothoracic leg. Metathoracic leg (pl. 1, fig. 14) about one and one-fifth times as long as mesothoracic. Differing from both pro- and mesothoracic legs as follows: shorter but more prominent coxa; shorter but more prominent trochanter, which is produced subglobosely entally; three prominent longitudinal ridges on tibia which are beset with rows of short bristles; one short, ectobasal and one middle spur; three relatively longer, closely apposed ectodistal spurs; and one long, stout, movable, entodistal spur; tarsus as long as tibia, three segmented, I about two-thirds total length of tarsus, five apposed, moderately long, ectodistal, and two entodistal spurs; II about one-half as long as I, four apposed ectodistal spines; III about as long as II.

Fore wing (pl. 1, fig. 10) elongately subelliptical, about three times as long as broad, extending beyond posterior end of abdomen, sparsely beset ectally along veins with whitish brown hairs; veins coarsely punctate with white dots; a broad, black, irregular, diffuse fascia along middle extending distally from humeral angle and becoming broader from subapex to apex; five brown spots bordering distal fourth of costal margin, apex and inner margin, between branches of longitudinal veins. Hind wing (pl. 1, fig. 11), membranous, uniformly hyaline, subtriangular, sparsely beset with very minute, almost inconspicuous hairs, about twice as long as broad, about two-thirds as long as fore wing, rounded at apex, broadly arcuate at inner margin.

Abdomen, subovate, about three-fifths total length of body, slightly broader than thorax, about two-thirds as long as broad, covered with numerous minute hairs, punctate; nine distinct segments; numerous lateral bristles at IV, V, and VI; the rest without. Pygofer thickly beset with hairs, especially along posterior margin, about two-thirds as long as broad and one-third as thick, strongly deflected dorsocaudally. Anal ring about

one-half as long and three-elevenths as thick as pygofer, broader posteriorly; anal style subellipsoidal, rounded apically, about one and one-half times as long as broad, inserted in anal ring by a peduncular process which is about two-thirds as broad as style. Aedeagus subconical, apex rounded, three acutely spiniform processes projecting from anterior end; about four times as long as broad, slightly smaller in diameter than anal style. Dorsal genital style about fifteen times as long as broad; a single subapical spine which describes with it an anteroventral angle of about 40°, acutely produced into a dorsally arcuate point, broad basally and acutely angulate distally (pl. 1, fig. 15).

Adult female (*pl. 1, fig. 8*). Length of body (exclusive of appendages) 4.42 millimeters; width 1.63; length of head 0.39; width 1.08; length of antenna 1.66; length of fore wing 4.87; width 1.39; length of hind wing 4.06; width 1.76.

The female is conspicuously larger than the male; lighter in color, especially in abdominal sternites, pro-, meso-, and metasterna, frons, clypeus, genae, labium and labrum, except at apex, which is dark brown. The large, black fascia, found on fore wing of male, absent, except small black spots intercepting distal ends of branches of longitudinal veins at costal margin, apex of wing, and inner margin. Anterior gonapophyses (pl. 1, fig. 16) about six and one-half times as long as distance at base, fuscous, horny, narrowly subfusiform, acutely angulate apically, slightly arcuate caudomesally, serrated at concave surface, except at base, inserted into more caudal abdominal sternite which telescopes into middle of fifth; a strongly deflected, laterocaudal, slightly attenuate, short extension basally at point of insertion. Posterior gonapophyses irregularly subgladiate, subunicolorous and thinner than anterior gonapophyses, very acutely pointed distally, about ten-elevenths as long, and one-fourth as broad, as anterior gonapophyses, about nineteen times as long as broad, closely apposed ectally to anterior gonopophyses. Sheath of ovipositor conspicuously lighter in color than gonapophyses, of uniform texture throughout, sublanceolate, acutely angulate distally, about fourteen times as long as width at base, about as long as anterior gonapophyses and about two-thirds as broad as distance at base of latter; a ventrocaudal mesal slit for protrusion of gonapophyses. Extension of gonapophyses-bearing, telescoping segment about two and one-half times as long as broad from ventral aspect. Anal segment about two-thirds as long as broad; numerous hairs ventrally; a caudal, vaguely subtrapezoidal extension, which is about one-half as long, and likewise as broad, as anal segment.

Fifth instar (*pl. 1, fig. 6*). Length of body (exclusive of appendages) 4 millimeters; width 1.38; length of head 0.32; width 0.98; length of antenna 1.37.

General color of body light brown, uniformly beset with very minute hairs. Similar to adult as follows: Prominence and arrangement of

carinae, characteristic markings, relative proportions of parts of legs, including bristles and spurs. Differing from adult as follows: five subcircular, punctiform depressions on either side near each anterolateral margin of pronotum; each depression circumscribed by subelliptical yellowish brown areas, which are arranged subregularly on a broad background of dark brown marginal band; one similar but smaller depression on either side of mesonotum, and three others near base of fore-wing pad, with neither circumscribing light area nor dark background. Tarsi of pro- and mesothoracic legs apparently two-segmented; those of metathoracic distinctly three-segmented. Fore-wing pad about four times as long as broad, subspatulate, rounded apically, emarginate at inner margin; dark brown spot at distal half, as in adult male. Hind-wing pad subtriangular, obtusely angulate apically, about three-fourths as long and about one and one-half times as broad as fore-wing pad, marked with irregular, diffuse, light brown spots. Two porrect, nearly parallel, subconical, posteriorly directed projections from ninth abdominal segment.

Fourth instar (*pl. 1, fig. 5*). Length of body (exclusive of appendages) 3.38 millimeters; width 1.22; length of head 0.31; width 0.92; length of antenna 1.17.

In characters of body and appendages, practically as in fifth instar.

Third instar (*pl. 1, fig. 4*). Length of body (exclusive of appendages) 2.76 millimeters; width 0.95; length of head 0.25; width 0.7; length of antenna 0.91.

Body light brown. Similar to later instars as follows: prominent carinae and markings of head, characteristic sensoria and bristles on antennae, subcircular, punctiform depressions of pronotum, characteristics of pro- and mesothoracic legs. Differing as follows: revolute marginal carinae of head bordering eyes not prominent, tarsi of metathoracic legs apparently two-segmented; tarsal segment I subcylindrical, with the same number of spurs as in fifth, about four times as long as broad and one and one-third times as long as II; II subconical, acutely angulate apically, about three and one-half times as long as broad. Fore-wing pad subtrapezoidal, outer margin emarginate; irregular diffuse spots, as in fifth instar; about one and one-half times as long as broad. Hind-wing pad irregularly subtrapezoidal, about as long as broad, margins straight, apex describing angle of about 50°, similar in markings to fifth instar. Abdominal markings as in fifth instar, but lighter and more restricted toward margins of tergites.

Second instar (*pl. 1, fig. 3*). Length of body (exclusive of appendages) 1.56 millimeters; width 0.55; length of head 0.2; width 0.32; length of antenna 0.48.

Body light brownish stramineous. Similar to later instars as follows: markings and circular depressions of pronotum, presence of movable spur at apex of metathoracic tibia, characteristics of pro- and mesothoracic legs. Metathoracic leg, as in third instar; tarsi apparently with two segments.

Differing from later instars as follows: cephalic carinae not prominent and not extending to posterior margin of head, abdominal markings, higher and more restricted toward lateral margins of tergites. Wing-pads not developed but their location marked by dark brown spots on meso- and metathoraces.

First instar (*pl. 1, fig. 2*). Length of body (exclusive of appendages) 0.92 millimeters; width 0.35; length of head 0.2; width 0.29; length of antenna 0.33.

Body opaque whitish stramineous. Similar to later instars as follows: characteristic antennal sensoria, which are, however, not prominent, subcircular depressions of pronotum, presence of movable spur at apex of posterior tibia, uniformly two-segmented character of tarsi, and markings of pro-meso-, and metathoracic legs.

Wing pads absent, as in second instar. Spurs at proximal and middle portions of posterior tibia, which are characteristic of later instars, absent. Abdominal bristles absent. Carinae of head rudimentary.

Table for separation of nymphal instars

1.	Wing pads present	2
	Wing pads absent	3
2.	Posterior tarsi distinctly three-segmented. Fore- and hind-wing pads subcoextensive apically	4
	Posterior tarsi apparently two-segmented. Fore-wing pads extending to middle of costal margin of hind-wing pad. Length of body, exclusive of appendages, about 2 millimeters	Instar III
3.	No spur at either proximal or middle portion of hind tibia. Length of body, exclusive of appendages, less than 1 millimeter	Instar I
	A spur on ectoproximal and another at middle portion of hind tibia. Length of body slightly over 1.5 millimeter	Instar II
4.	Length of body, exclusive of appendages, about 4 and usually more than 3.5 millimeters	Instar V
	Length slightly over 3 millimeters, but less than 3.5 millimeters	Instar IV

Length of life cycle

The life history was determined on twenty-nine individual cultures. Lamp chimneys were used as breeding cages. Mass cultures in larger containers were used to check up results. Only the females were considered, although, of course, males were mated with them. The experiments were conducted during the period from August, 1925, to January, 1926, a total of about six months. This period was apparently the most favorable for *Perkinsiella*, as may be judged by examination of table 7a and 7b. The data for the life cycle are given in tables 1 and 1a.

It may be seen from these tables that the length of life cycle ranged from 32 to 66 days, with an average of 47.3 days. The maximum range does not appear to be an unusual extreme, since at least five of the cultures covered a period of over 60 days.

The period from emergence to first laying of eggs varied from 2 to 25 days; average 13.3 days.

Incubation period

Procedure. Fertilized adult females were kept in confinement on sugar cane and the dates of first oviposition and subsequently those of first egg hatching taken. The difference in the two dates in days is the incubation period of the eggs. The work covered the periods from September to December, 1925, and from January to May, 1926. No work on incubation was undertaken during June, July, and August, 1926, since no egg material in suitable quantities could be secured then. To determine the effect of environmental differences on duration of incubation period, the cultures were divided into three lots and treated as follows:

(1) In confinement in the insectary. The cages were about two and one-half meters above the level of the ground. The moderately air-tight wooden floor of the building almost completely insulated the cultures from the ground. The data are given in tables 1 and 1a.

(2) In the field, under shade.

(3) In the field, exposed to sun.

The results are given in table 2.

It will be seen in table 1 that the period of incubation in the insectary varied from 11 to 23 days, with an average of 15.2 days. Table 2 shows that the average incubation period in the field in the open ranged from 10.5 to 19.5 days, with an average of 13.9 days, and in the shade, from 13.2 to 21 days with an average of 17.3 days. From these data it may be seen that the average incubation period in the open was the shortest, being 13.9 days; that in the insectary came next, with 15.2 days; and that under shade the longest, with 17.3 days. The probable explanation for these differences is that on account of direct exposure to sunlight the temperature in the open was higher than that in either the laboratory or in the field under shade. The temperature in the insectary was higher than under shade in the field because the windows were closed at night, which made the rooms quite warm.

The work was not carried far enough to determine the relation between climatic factors and duration of incubation period. It appears, however, from a superficial observation that the scarcity of eggs in the months of June, July, and August, 1926, was due, among other causes, to the prevailing high temperature and lack of rainfall in May. Two other important causes were the prevalence of effective egg parasites during that season and the condition of the cane tissue, which was then for the most part too old for the female's ovipositor to penetrate.

A comparison of the duration of the nymphal stadia and of the nymphal stage in the two sexes

The material on which the present observations were based consisted of fifty-two individual cultures, twenty-three of which were males and twenty-nine females. The lot included seven cultures previously used and

reported in table 1a. The work was carried on two partly overlapping generations, starting in August, 1925, and ending in January, 1926. This period covered approximately the same period as that in the life cycle experiments, which, as noted above, was apparently the most favorable part of the year for *Perkinsiella*. The results are given in table 3.

The figures given in table 3 do not seem to indicate that there are any significant differences in the duration of each of the five nymphal stadia between the two sexes. The average for the first stadium for all the cultures, irrespective of sex, is very slightly larger than that for the second. From the second to the fifth stadium there is a noticeable small progressive increase in the length of time between molts.

The male and female averages for the total length of the nymphal stage are about the same, but the maximum and minimum figures for the female are more than for the male. If these figures mean anything, they may be taken as showing that individually the female may require a relatively longer time to mature than the male, the low average being due to the fact that a proportionately larger number of individuals come closer to the minimum range.

Copulation

The sexually mature female which is ready to mate tilts the body upward by means of the hind legs. The male then approaches invariably from the left side, and at pairing the body describes anterosinistrally an angle of about 70° with that of the female. Copulation lasts about an hour or more. The process does not seem to interfere with feeding in either sex. After they separate each stretches the wings laterally as if to prepare for flight, but the action is followed only by walking to a near-by spot on the leaf suitable for feeding.

Manner of oviposition

The female usually selects a site away from the congregation of other leaf-hoppers where the leaf midrib or inner surface of sheath or stem is young and succulent and has not previously been used by others for oviposition. After locating a suitable place, it holds fast on the plant part by means of its claws and then secretes at the tip of the abdomen a clear fluid, which is probably a lubricant for the ovipositor. It apparently first feels by means of the distal end of the ovipositor for the most vulnerable part of the tissue. The ovipositor is then gradually thrust into the spot by an up and down movement, the egg-guide being buried deeper and deeper at each descent. It seems that the ultimate result of this action is to form underneath the plant epidermis a chamber which is sufficiently large to accommodate more than one egg. The number of eggs laid in each of these compartments is discussed later in the present paper.

Oviposition on the leaf midribs which are exposed is limited to the cooler parts of the morning and the afternoon; on the more protected inner

surfaces of leaf sheaths or on stems, the process may occur at any time of the day, even during the noon hours.

Number and position of eggs in the leaf

Objects. (1) To determine the total number of eggs present in each infested leaf; (2) number in each group as indicated by oviposition puncture in leaf; (3) position of eggs with respect to host tissue.

Procedure. Leaves bearing eggs were collected from the field and dissected in the laboratory.

Results. The results are given in tables 4 and 5.

It may be seen from tables 4 and 5 that from 1 to 4 eggs are present under each oviposition puncture, the average being 2.32.

From 6 to 1,836 eggs with an average of 439.4, were found in a single infested leaf. Of the two varieties considered, Badila bore the larger number of eggs to the leaf, with Luzon White having a relatively much smaller number.

The eggs were usually placed in the leaves at an angle of about 30° to 55° with the upper epidermis of the midrib. The concave sides of the eggs pointed in the same direction and were, as a rule, nearest the leaf surface (see pl. 1, fig. 18).

Feeding and other habits

The semigregarious habit of the insect has been noted in first part of the present paper. As many as one hundred individuals in all stages of growth have been counted on an infested leaf area. The nymphs predominate in number, the adults being relatively very few. The explanation of this condition may be that the eggs are laid in large batches on a given leaf or sheath area and the nymphs hatching therefrom do not wander very far in order to feed. The adults, on the other hand, may fly away and be carried by wind even to other cane plants. So firmly settled are the nymphs on the place where they are feeding that, if disturbed, they merely dodge the intrusion by a short run or jump and then return to their original location soon after they are left undisturbed. They usually select the more succulent leaves or softer leaf sheaths as their feeding areas.

When ready to molt, the young insect holds fast on the leaf surface by means of its claws and flexes the body ventrally. A dorsomesal rupture then appears from the head to the pronotum and the next instar breaks head first through the slit thus made.

The normal color is not restored until after a lapse of about six hours.

Number of generations during the year with a consideration of the effect of changes of climatic factors on duration of life cycle

The experiments were conducted in the field under two different conditions; namely, (1) in the shade, and (2) in the open. The work was begun

on September 6, 1925, and closed on September 7, 1926, covering a period of one year.

Four mass cultures were used in the shade and two in the open. In the shade, young canes transplanted in pots were used as breeding media and large Dietz-lantern chimneys covered over the top with cheese cloth as cages; in the open, canes growing on field plats and cages made of cheese cloth wrapped around bamboo frames.

The results are given in tables 6, 7a, 7b, and charts 1, 2, and 3.

On the basis of the results in the foregoing tables and charts the following conclusions are drawn:

1. Under artificial conditions, such as those in which the present experiments were conducted, five generations during the year were possible in the open and six in the shade.

2. The only months in which *Perkinsiella* could carry on its active generative cycles were: in the open, from July, 1925 until April of the year following, or a total of about nine months; in the shade from July, 1925 until June of the year following, or a total of about eleven months. Tables 7a and 7b begin the record in September, and not in August, since the former month was the time in which the insect began to appear in sufficiently abundant quantities for experimental work.

3. It was not possible to get any of the insects to live in confinement in the open during May, June, and July, 1926, and during July in confinement in the shade. In the field the number of *Perkinsiella* individuals began to decrease about the middle of March; in April, May, June, and July, none could be found among the plants visited; and the insect did not begin to reappear until about the middle of September. This condition was apparently brought about by the following causes:

a. Protracted dryness in February, March, and April, 1926, and, to some extent, in May and June, evidently affected the food supply. The effect was more immediate in the open than under shade (chart 3).

b. In March, April, May, and June, 1926, temperature was much higher than in other months under observation (chart 1) and the hot days came in more frequent succession. The maximum temperature for March was 31.4°C.; for April, 33.3°C.; for May, 33.5°C.; and for June, 30.3°C. The prevalence of hot weather in combination with scarcity of rainfall evidently brought about conditions unfavorable to *Perkinsiella*, by rendering the food supply inadequate, and in the open, through direct effect of protracted heat on the nymphs and adults. Moreover, the sugar cane plants during these months were, as a result of these untoward climatic factors, inhibited from producing young succulent tissues wherein eggs could be inserted, and oviposition was thus seriously hampered.

c. The canes were then mature and ready to harvest.

d. Natural enemies, particularly egg parasites, apparently decimated the host. As noted elsewhere in the present paper, they were abundant in Los Baños in November and December.

e. Relative humidity appeared to be highest during the period of greatest scarcity of *Perkinsiella* (chart 2).

4. The shortest average life cycle found was 39.5 days and the longest, 57.7.

5. Taking the period when the life cycle is the shortest as presumably the most favorable, it will be seen that the months of September and October, 1925, represented optimum conditions for carrying on the insect's vital activities. The heavy precipitation which began in July and continued through to this period, with the consequent effect on the host plant, and the relatively lower temperature prevailing then, apparently were the determining factors.

6. Correspondingly, January and February, 1926, apparently represented the most unfavorable months, the life cycle being relatively the longest then. These months represented the beginning of the dry season, when climatic factors, especially the rise in temperature, directly affected the insect and the scarcity of rainfall in conjunction with other environmental agencies exerted indirect influence on the insects mainly through bringing about changes in the host plant.

7. The effect of changes in climatic factors on the length of life cycle appeared to be more marked under shade than in the open. The probable explanation is that the host plants under shade had never been in the best of condition owing to inability to carry on photosynthesis normally. Under the circumstances they would be more readily susceptible to any additional untoward effect of the environment. The effect on the host became reflected on the insects which fed on them.

Natural enemies

Parasitic and predaceous insects, spiders, fungi, and other natural agents evidently play an important part in keeping down the number of *Perkinsiella vastatrix*. The following were met with in the course of the present investigation:

Egg parasites (endoparasites)

a. A species of Mymaridae (Hymenoptera)[4]

b A species of Proctotrupidae (Hymenoptera)[4] Egg predator.

A species of Capsidae (Hemiptera). This species punctures the egg shell and sucks the contents. Predaceous both in the nymphal and adult stages.

Ectoparasites on nymphs and adults.

Two apparently distinct species of mites.

These are probably of minor or no importance as natural control agents.

Endoparasites in nymphs and adults.

A species of entomophagous fungus.

Predators on nymphs and adults

[4] These insects have been sent abroad for identification.

a. *Proreus simulans* Stal. (Forficulidae, Dermaptera). Known also in British India. "Widely distributed in Oriental region." (Burr, 1910.)

b. *Chelisoches morio* Fabr. (Forficulidae, Dermaptera.) Terry (1905) notes that this "species has a wide distribution in the islands of the Pacific Ocean, and is recorded from Tahiti, Fiji, Hawaii, New Guinea, Java, Sumatra, Celebes, Philippines, Batchian, India, and Ceylon." This author gives complete descriptions of the four nymphal instars and the adult stage and also a general biological account.

c. *Paederus fuscipes* Curt. (Staphylinidae, Coleoptera.) This species is also known in Europe, where it is widely distributed (Harold, 1868).

d. Species of jumping spiders (Attidae).

The extent to which parasitism occurs was studied in detail in the present work in connection with the eggs of *Perkinsiella*. The results are given in table 8.

Table 8 shows that the percentage of parasitism of eggs by Mymarids varied from 17.68 to 98.63, with an average of 52.01. The egg parasites appeared in large numbers in the month of November, 1925. The adult Mymarids could be seen covering almost every new eggspot from early in the morning till about dark in the evening. This species of egg parasites also appeared in large numbers in November and December, 1926. It is evident that they are most abundant in November and December, although they are to be found in smaller numbers in other parts of the year whenever eggs of *Perkinsiella* are available.

Seasonal occurrence

Observations on the seasonal occurrence of *Perkinsiella* in the field were started in July, 1925, and carried through to January 16, 1927. At first only the Experiment Station grounds were covered, but, later on, the work was extended to other fields in the vicinity. The data are given in table 9.

Only monthly observations were made from July, 1925 to March, 1926, but thereafter weekly visits were made.

The following conclusions were drawn:

1. The month when greatest abundance of *Perkinsiella* nymphs and adults prevailed was November, 1925. As shown elsewhere in the present paper, the two months preceding, September and October, represented the period in which conditions were most favorable for *Perkinsiella* in carrying on its vital activities. It is not strange then that in November the insect was found to be most numerous. In certain fields, *Perkinsiella* was very abundant from October to January.

2. The severe typhoon in Los Baños on November 5, 1926, killed many of the insects, so that by December of that year they began to be scarce. *Perkinsiella*, however, previous to the typhoon, had been abundant at approximately the periods corresponding to those of 1925.

3. Natural enemies, particularly egg parasites, were abundant in November and December, 1925, and in November, 1926. This condition is to be expected, since the host was most abundant then.

4. In the two years, 1926 and 1927, *Perkinsiella* began to be scarce in January.

5. No *Perkiensiella* could be found in any of the fields visited in Los Baños and vicinity in March, 1926, and in the same month of 1927. It may be noted that possibly among the most important causes leading to its disappearance was that most of the canes were then too old for feeding and oviposition. Harvesting time in Los Baños is generally in February and March.

6. In 1926, the insect began first to appear in noticeable quantities in September. This was three months later than the first appearance in 1925, which was in July. The probable immediate cause is the longer and hotter dry season in 1926.

Relative degrees of susceptibility of different cane varieties in Los Baños

Observations were made weekly, on either Saturday or Sunday, from January 7, 1926, when new plantings were set out by the Plant Breeding Division, to October 30, 1926. The work could not be carried on after this date, as nearly all the plants were destroyed by typhoon on November 5, 1926.

The following terms were used in evaluating degrees of susceptibility of the different varieties.

1. *Light infestation*—each cane leaf with not more than one hundred egg spots.

2. *Medium infestation*—each cane leaf with over one hundred, but not more than three hundred, egg spots.

3. *Heavy infestation*—around six hundred egg spots to each leaf.

4. *Very heavy infestation*—cane very heavily attacked; so much so that even stems bore egg spots.

Examining table 10, it may be seen that Uba, H 109, Toledo, Morado. D. I. 52, C. A. C. 87, P. B. 68, and P. B. 94 are subject to light infestation. These varieties were found to be relatively the least susceptible to the attack of the pest in all stages of growth through the entire period of observation. Cebu Purple, C. A. 18156, Variation of Striped Tanna, P. B. 158, P. B. 117 were under medium infestation, except the last, which at first was heavily infested but later on became less so as the other varieties became available.

The infestation on Pampanga Purple, Luzon White, Luzon Striped, Negros Purple, P. B. 119, 124, 142, 148, seedlings of P. B. 121, C. A. N, 18158, 18159, Java 247 came gradually, light at first, then increased progressively until heavy infestation was reached. Pampanga Purple Striped, which is a bud sport of Pampanga Purple, and Badila were found to be very heavily infested from the beginning.

The foregoing data indicate that, other things being equal, there are cane varieties which promise to be relatively less susceptible to *Perkinsiella* infestation than others. Further work along these lines should be done to establish the varieties best suited to grow in heavily attacked regions.

SUMMARY AND CONCLUSIONS

1. *Perkinsiella vastatrix* Breddin (1896), Delphacidae, Delphacini (Homoptera), is one of the relatively important pests of sugar cane in the Philippine Islands.

2. The insect is apparently confined to the Oriental Region and a small part of the Palaearctic (Japan only).

3. It is probably autochthonous in the Philippine Islands, in common with other Oriental countries.

4. Sugar cane is the only known host of this insect in the Philippines. Since this plant is an introduced species in this country the original host was presumably some wild native grass, probably the talahib, *Saccharum spontancum* subsp. *indicum* Hack. It appears, however, that since the arrival of the sugar cane, this plant has become the preferred host to the exclusion of all others.

5. The injury to the cane consists of lesions in the upper surface of leaf midribs or leaf sheaths, and to a lesser degree, in stems resulting from feeding by nymphs, as well as adults, and from oviposition. The work of the insect is often followed by secondary complications, such as invasion through the wounds by pathogenic microorganisms.

6. Sugar cane generally begins to become susceptible to the attack of the pest when it begins to stool about one and one-half months from plant cane and about four months from rattooning. Very old canes which are ready to harvest are relatively free from attack.

7. Descriptions of the egg and the different postembryonic instars are given.

8. The life cycle ranged as follows: individual, 32 to 66 days; average 39.5 to 57.7 days. In the present work the shortest average life cycle was found to occur in September and October, 1925; the longest, in January and February, 1926.

9. Copulation lasts about one hour or more.

10. The time elapsing from emergence of adult female to first oviposition was 2 to 25 days; average, 13.3.

11. Each infested leaf was found to contain a total of from 6 to 1,836 eggs; average, 439.4.

12. In each egg chamber, underneath the oviposition puncture in the leaf, there were found from 1 to 4 eggs; average, 2.32.

13. Incubation period of the eggs in the open was from 10.5 to 19.5 days; average, 13.9 days; in the shade, 13.2 to 21; average, 17.3.

14. There are five nymphal instars, the fifth molt marking the transition to the adult stage.

15. The nymphs and adults are semigregarious. The nymphs are practically stationary on one feeding area; the adults usually fly away and with the aid of the wind migrate to another part of the same plant or to other plants.

16. During the period covered by the present experiments there were in one year's time five generations in the open and six in the shade.

17. The insect could apparently pass through active generative cycles during only a part of the year; the rest of the time it was probably in some dormant stage which the present observations failed to establish.

18. The favorable growing months were from July, 1925, to April, 1926, or a total of about nine months in the open; and from July, 1925, to June, 1926, or a total of about eleven months in the shade. The insect could not be made to live in confinement in the open in May, June, and July, 1926, and in the shade in July, 1926.

19. In nature, *Perkinsiella* was most abundant in November, 1925, following the favorable growing months of September and October. It began to decrease in number in January, 1926, and in March began to be extremely scarce. It may be noted in this connection that apparently the most unfavorable growing months, wherein life cycle was longest during the year, were January and February. No *Perkinsiella* could be found in any stage in the fields visited in May, June, and July, 1926. The insect first began to reappear in noticeable quantities in September. Several causes may be adduced for this suspension of vital activities, most important among which were protracted dryness during those months in combination with high relative humidity; condition of the cane plants, which were then mature and ready to harvest, so that the tissues were too tough for piercing, both in feeding and in oviposition; and as an after effect of the prevalence of natural enemies previously in November and December, 1925.

20. Climatic factors apparently produced a more telling effect on the insect in the shade than in the open.

21. In the severe typhoon of November 5, 1926, many of the insects were beaten to death, so that by December they began to be scarce.

22. The following natural enemies were found: Two species of egg endoparasites, one species of egg predator, one species of entomophagous fungus infecting nymphs and adults, and four species of predators on nymphs or adults. Of these natural enemies the most effective was apparently a Mymarid, which parasitized the eggs to the extent of from 17.68 to 98.63 per cent; average, 52.00 per cent.

23. Different varieties of sugar cane exhibited varying degrees of susceptibility to the attack of *Perkinsiella*. In the present work, the following varieties were found to be least damaged: Uba, H 109, Toledo,

Morado, D. I. 52, C.A.C. 87, P. B. 68, and P. B. 94. Most heavily infested: Pampanga Purple striped and Badila.

24. On the basis of the results obtained in the present work the following control measures are tentatively suggested, pending more thorough investigation along these lines:

a. Planting of resistant or relatively less susceptible varieties.

b. Encouragement of natural enemies. If conditions warrant, reënforcement of existing native natural enemies by importation and colonization of exotic species.

c. Rotation of crops would not be advisable unless the practice could be coördinated and made general over large areas. Since *Perkinsiella* is apparently a monophagous, or at most oligophagous, pest, almost any crop may follow sugar cane in rotation, the only possible exceptions being sorghum and corn.

d. Regulation of the time of planting is not deemed practicable, since sugar cane is susceptible to attack over a long period during its life—eight months or over—and *Perkinsiella* is scarce or wanting in active stages during only about four months.

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ILLUSTRATIONS

(Magnifications indicated refer to size of original figures)

Plate 1

Fig. 1. Egg of *Perkinsiella vastatrix*, × 120
2. Nymph, first instar, dorsal view, × 36.5
3. Nymph, second instar, dorsal view, × 36.5
4. Nymph, third instar, dorsal view, × 36.5
5. Nymph, fourth instar, dorsal view, × 36.5
6. Nymph, fifth instar, dorsal view, × 36.5
7. Adult male, dorsal view, × 30
8. Adult female, dorsal view, × 30
9. Head of male, frontal view, × 91.6
10. Right fore wing of male, dorsal view, × 36.5
11. Right hind wing of male, dorsal view, × 36.5
12. Right prothoracic leg of male, × 58.3
13. Right mesothoracic leg of male, × 58.3
14. Right metathoracic leg of male, × 58.3
15. Male genitalia, × 120
16. Female genitalia, × 77
17. Right antenna of male, × 176
18. Eggs *in situ* in dissected leaf midrib (semi-diagrammatic), × 15

Plate 2

Fig. 1. Sugar cane leaf sheaths (left) and stem (right) showing damage from oviposition by *Perkinsiella*.
Fig. 2. Sugar cane leaves showing damage on midribs from oviposition by *Perkinsiella*.

TABLE 1

Life cycle of Perkinsiella vastatrix, female (under laboratory conditions)

CULTURE NO.	EGGS HATCHED	ADULTS EMERGED	DURATION OF NYMPHAL STAGE	EGGS LAID	PERIOD FROM EMERGENCE TO FIRST LAYING OF EGGS	EGGS HATCHED	PERIOD OF INCUBATION	LENGTH OF LIFE CYCLE
	1925	1925	*days*	1925	*days*	1925	*days*	*days*
2	14–VIII	4–IX	21	29–IX	25	18–X	20	66
3	15–VIII	4–IX	20	9–IX	15	24–IX	15	39
4	15–VIII	3–IX	19	8–IX	4	26–IX	18	42
5	15–VIII	29–VIII	14	6–IX	8	18–IX	12	34
6	15–VIII	29–VIII	14	6–IX	8	18–IX	12	34
7	15–VIII	3–IX	19	6–IX	3	18–IX	12	34
8	15–VIII	2–IX	18	6–IX	4	18–IX	12	34
9	16–VIII	6–IX	21	15–IX	9	2–IX	18	48
11	16–VIII	3–IX	18	6–IX	4	18–IX	12	33
13	16–VIII	2–IX	17	6–IX	3	23–IX	17	38
16	19–VIII	9–IX	21	18–IX	9	7–IX	20	50
17	19–VIII	5–IX	17	11–IX	6	29–IX	18	41
19	28–VIII	14–IX	17	18–IX	4	30–IX	12	34
20	29–VIII	15–IX	17	18–IX	3	30–IX	12	32
21	29–VIII	15–IX	17	28–IX	13	15–X	18	48
22	29–VIII	16–IX	18	18–IX	2	30–IX	12	32
23	30–VIII	19–IX	20	3–IX	15	21–X	18	53
				1926		1926		
27	3–XII	29–XII	26	14–I	16	2–II	19	61
28	3–XII	30–XII	27	14–I	15	2–II	19	61
30	6–XII	27–XII	21	15–I	19	7–II	23	63
32	6–XII	1–I–'26	26	16–I	15	6–II	21	62
38	8–XII	27–XII	19	15–I	19	3–II	19	57
			carried from table 1a					
23a	———	———	20	——	25	——	13	58
24a	———	———	20	——	24	——	13	57
25a	———	———	17	——	23	——	12	52
26a	———	———	22	——	19	——	12	53
27a	———	———	21	——	22	——	12	55
28a	———	———	18	——	23	——	11	52
29a	———	———	17	——	23	——	11	51
Maximum	———	———	27	——	25	——	23	66
Minimum	———	———	14	——	2	——	11	32
Average	———	———	19.3	——	13.3	——	15.2	47.3

TABLE 1a

Life cycle of Perkinsiella vastatrix, female (under laboratory conditions)

CULTURE NO.	EGGS LAID	EGGS HATCHED	PERIOD OF INCUBATION	ADULTS EMERGED	DURATION OF NYMPHAL STAGE	EGGS LAID	PERIOD FROM EMERGENCE TO FIRST LAYING OF EGGS	LENGTH OF LIFE CYCLE
	1925	1925	*days*	1925	*days*	1926	*days*	*days*
23a	20–XI	3–XII	13	23–XII	20	17–I	25	58
24a	20–XI	3–XII	13	23–XII	20	16–I	24	57
25a	25–XI	7–XII	12	24–XII	17	16–I	23	52
26a	26–XI	8–XII	12	30–XII	22	18–I	19	53
27a	26–XI	8–XII	12	29–XII	21	20–I	22	55
28a	26–XI	7–XII	11	25–XII	18	17–I	23	52
29a	27–XI	8–XII	11	25–XII	17	17–I	23	51

TABLE 2

Incubation period (field experiment)

	LOTS IN THE OPEN			LOTS IN THE SHADE				
	I	II	Average	I	II	III	IV	Average
	1925	1925	*days*	1925	1925	1925	1925	*days*
Eggs laid	7–IX	6–IX	——	7–IX	7–IX	7–IX	7–IX	——
Hatched	23–IX	18–IX	——	23–IX	23–IX	23–IX	23–IX	——
Incubation period	16 days	12 days	14.0	16 days	16 days	16 days	16 days	16.0
Eggs laid	19–X	13–X	——	19–X	19–X	19–X	19–X	——
Hatched	3–XI	19–IX	——	2–XI	2–XI	2–XI	2–XI	——
Incubation period	15 days	6 days	10.5	14 days	14 days	15 days	14 days	14.2
Eggs laid	1–XII	2–XII	——	2–XII	2–XII	3–XII	2–XII	——
Hatched	12–XII	15–XII	——	22–XII	23–XII	23–XII	25–XII	——
Incubation period	11 days	13 days	12.0	20 days	21 days	20 days	23 days	21.0
	1926	1926		1926	1926	1926	1926	
Eggs laid	20–I	15–I	——	23–I	30–I	30–I	2–II	——
Hatched	3–II	28–I	——	7–II	12–II	13–II	14–II	——
Incubation period	14 days	13 days	13.5	15 days	13 days	14 days	12 days	13.5
Eggs laid	9–III	5–III	——	18–III	23–III	22–III	24–III	——
Hatched	27–III	26–III	——	5–IV	6–IV	6–IV	6–IV	——
Incubation period	18 days[a]	21 days[a]	19.5	18 days	17 days	15 days	13 days	13.2
Eggs laid	——	——	——	9–V	10–V	12–V[b]	12–V	——
Hatched	——	——	——	24–V	25–V	——	26–V	——
Incubation period	——	——	——	15 days[a]	15 days[a]	——	14 days[a]	14.5
Maximum	——	——	19.5	——	——	——	——	21.0
Minimum	——	——	10.5	——	——	——	——	13.2
Average	——	——	13.9	——	——	——	——	17.3

[a] Only few eggs were hatched.

[b] Eggs were not hatched.

TABLE 3

Duration of nymphal stadia and total length of nymphal

NUMBER	SEX	HATCHED	FIRST MOLT	FIRST STADIUM	SECOND MOLT	SECOND STADIUM	THIRD MOLT	THIRD STADIUM	FO
		1925	1925	*days*	1925	*days*	1925	*days*	
1	male	14–VIII	16–VIII	2	21–VIII	5	23–VIII	2	
2	female	14–VIII	18–VIII	4	20–VIII	2	22–VIII	2	
3	female	15–VIII	19–VIII	4	24–VIII	5	28–VIII	4	
4	female	15–VIII	18–VIII	3	21–VIII	3	25–VIII	4	
5	female	15–VIII	18–VIII	3	20–VIII	2	22–VIII	2	
6	female	15–VIII	18–VIII	3	20–VIII	2	23–VIII	3	
7	female	15–VIII	19–VIII	4	23–VIII	4	27–VIII	4	
8	female	15–VIII	19–VIII	4	22–VIII	3	25–VIII	3	
9	female	16–VIII	23–VIII	7	25–VIII	2	28–VIII	3	
10	male	16–VIII	21–VIII	5	23–VIII	2	27–VIII	4	
11	female	16–VIII	19–VIII	3	23–VIII	4	26–VIII	3	
12	male	16–VIII	20–VIII	4	27–VIII	7	30–VIII	3	
13	female	16–VIII	17–VIII	1	20–VIII	3	24–VIII	4	
14	male	16–VIII	20–VIII	4	23–VIII	3	29–VIII	4	
15	male	18–VIII	21–VIII	3	24–VIII	3	28–VIII	4	
16	female	19–VIII	24–VIII	5	28–VIII	4	31–VIII	3	
17	female	19–VIII	23–VIII	4	26–VIII	3	30–VIII	4	
18	male	19–VIII	21–VIII	2	23–VIII	2	27–VIII	4	
19	female	28–VIII	1–IX	4	3–IX	2	6–IX	3	
20	female	29–VIII	2–IX	4	5–IX	3	9–IX	4	
21	female	29–VIII	2–IX	4	5–IX	3	9–IX	4	
22	female	29–VIII	3–IX	5	7–IX	4	11–IX	4	
23	female	30–VIII	3–IX	4	6–IX	3	10–IX	4	
24	male	30–VIII	3–IX	4	6–IX	3	9–IX	3	
25	male	3–XII	8–XII	5	12–XII	4	16–XII	4	
26	male	3–XII	8–XII	5	13–XII	5	16–XII	3	
27	female	3–XII	8–XII	5	12–XII	4	16–XII	4	
28	female	3–XII	8–XII	5	13–XII	5	16–XII	3	
29	male	3–XII	6–XII	3	10–XII	4	15–XII	5	
30	female	6–XII	10–XII	4	12–XII	2	14–XII	2	
31	male	6–XII	10–XII	4	14–XII	4	17–XII	3	
32	female	6–XII	10–XII	4	15–XII	5	19–XII	4	
33	male	7–XII	11–XII	4	14–XII	3	19–XII	5	
34	male	7–XII	11–XII	4	14–XII	3	19–XII	5	
35	male	8–XII	11–XII	3	15–XII	4	20–XII	5	
36	male	8–XII	12–XII	4	16–XII	4	19–XII	3	
37	male	8–XII	12–XII	4	16–XII	4	19–XII	3	
38	female	8–XII	14–XII	6	18–XII	4	21–XII	3	
39	male	9–XII	11–XII	2	14–XII	3	17–XII	3	
40	male	9–XII	10–XII	1	14–XII	4	19–XII	5	
							1926		
41	male	24–XII	25–XII	1	29–XII	4	3–I	5	
42	male	24–XII	26–XII	2	29–XII	3	3–I	5	
43	male	24–XII	25–XII	1	30–XII	5	4–I	5	
44	male	25–XII	27–XII	2	31–XII	5	5–I	5	
45	male	27–XII	29–XII	2	31–XII	2	4–I	4	
					carried from table 1a				
23a	female	——	——	——	——	——	——	——	
24a	female	——	——	——	——	——	——	——	
25a	female	——	——	——	——	——	——	——	
26a	female	——	——	——	——	——	——	——	
27a	female	——	——	——	——	——	——	——	
28a	female	——	——	——	——	——	——	——	

Male						
Maximum	5	——	7	——	5	
Minimum	1	——	2	——	2	
Average	3	——	3.7	——	4	
Female						
Maximum	7	——	5	——	5	
Minimum	1	——	2	——	2	
Average	4	——	3.2	——	3.3	
Average for male and female	3.5	——	3.4	——	3.6	

TABLE 4

Number of eggs under each oviposition puncture in leaf

PUNCTURE NUMBER	DATE	NUMBER OF EGGS
	1926	
1	2–XI	4
2	2–XI	1
3	2–XI	3
4	2–XI	2
5	2–XI	4
6	2–XI	3
7	2–XI	3
8	2–XI	3
9	2–XI	3
10	2–XI	3
11	2–XI	2
12	2–XI	3
13	2–XI	4
14	2–XI	3
15	2–XI	4
16	2–XI	3
17	2–XI	2
18	2–XI	4
19	2–XI	3
20	2–XI	4
21	2–XI	2
22	2–XI	3
23	2–XI	4
24	2–XI	2
25	2–XI	2
26	2–XI	2
27	2–XI	2
28	2–XI	1
29	2–XI	3
30	2–XI	2
31	2–XI	2
32	2–XI	1
33	2–XI	3
34	2–XI	2
35	2–XI	4
36	2–XI	3
37	2–XI	3
38	2–XI	1
39	2–XI	1
40	2–XI	3
41	2–XI	4
42	2–XI	1
43	2–XI	1
44	2–XI	1
45	2–XI	3
46	2–XI	2
47	2–XI	1
48	2–XI	3
49	2–XI	2
50	2–XI	2
51	2–XI	1
52	2–XI	2

TABLE 4—Continued

Number of eggs under each oviposition puncture in leaf

PUNCTURE NUMBER	DATE	NUMBER OF EGGS
	1926	
53	2–XI	1
54	2–XI	3
55	2–XI	1
56	2–XI	1
57	2–XI	3
58	2–XI	1
59	2–XI	4
60	2–XI	3
61	2–XI	3
62	2–XI	1
63	2–XI	3
64	2–XI	3
65	2–XI	2
66	2–XI	1
67	2–XI	1
68	2–XI	1
69	2–XI	3
70	2–XI	1
71	2–XI	2
72	2–XI	1
73	2–XI	1
74	2–XI	1
75	2–XI	2
76	2–XI	2
77	2–XI	1
78	2–XI	2
79	2–XI	2
80	2–XI	1
81	2–XI	2
82	2–XI	3
83	2–XI	2
84	2–XI	3
85	2–XI	4
86	2–XI	2
87	2–XI	4
88	2–XI	2
89	2–XI	2
90	2–XI	4
91	2–XI	2
92	2–XI	2
93	2–XI	1
94	2–XI	3
95	2–XI	1
96	2–XI	2
97	2–XI	3
98	2–XI	2
99	2–XI	3
100	2–XI	3
Maximum	——	4
Minimum	——	1
Average	——	2.32

TABLE 5

Number of eggs in each leaf, including sheath

LEAF NUMBER	DATE	SUGAR CANE VARIETY USED	NUMBER OF EGGS
	1925		
1	August	Luzon White	12
2	"	"	24
3	"	"	20
4	"	"	14
5	"	"	6
6	"	"	10
7	"	"	24
8	"	"	14
9	"	"	24
10	"	"	20
11	"	"	4
12	"	"	20
13	"	"	18
14	"	"	30
15	"	"	18
16	"	"	15
17	"	"	39
18	"	"	20
19	"	"	36
20	"	"	32
21	"	"	28
22	"	"	15
23	"	"	12
24	"	"	30
25	"	"	21
26	"	"	20
	1926		
27	14–XI	Badilla	1016
28	14–XI	"	1213
29	14–XI	"	1074
30	14–XI	"	1572
31	14–XI	"	1104
32	14–XI	"	1373
33	14–XI	"	1612
34	14–XI	"	897
35	14–XI	"	1836
36	14–XI	"	988
37	14–XI	"	793
38	14–XI	"	1014
39	14–XI	"	1239
40	14–XI	"	760
41	14–XI	"	1076
42	14–XI	"	921
43	14–XI	"	941
44	14–XI	"	1521
45	14–XI	"	1141
46	14–XI	"	749
47	14–XI	"	1108
48	14–XI	"	756
49	14–XI	"	1339
50	14–XI	"	806
51	14–XI	"	1143

TABLE 5—Continued

Number of eggs in each leaf, including sheath

LEAF NUMBER	DATE	SUGAR CANE VARIETY USED	NUMBER OF EGGS
	1926		
52	10–XII	Luzon White	310
53	10–XII	"	306
54	10–XII	"	299
55	10–XII	"	252
56	10–XII	"	331
57	11–XII	"	299
58	11–XII	"	505
59	11–XII	"	273
60	11–XII	"	549
61	11–XII	"	329
62	11–XII	"	194
63	11–XII	"	213
64	11–XII	"	303
65	11–XII	"	213
66	11–XII	"	354
67	11–XII	"	201
68	11–XII	"	241
69	11–XII	"	294
70	11–XII	"	238
71	11–XII	"	136
72	11–XII	"	198
73	11–XII	"	401
74	11–XII	"	331
75	11–XII	"	283
76	11–XII	"	677
77	11–XII	"	561
78	11–XII	"	132
79	11–XII	"	180
80	11–XII	"	343
81	11–XII	"	495
82	11–XII	"	610
83	11–XII	"	296
84	11–XII	"	546
85	11–XII	"	399
86	11–XII	"	395
87	11–XII	"	180
88	11–XII	"	215
89	11–XII	"	132
90	11–XII	"	192
91	11–XII	"	97
92	11–XII	"	296
93	11–XII	"	120
94	11–XII	"	415
95	11–XII	"	155
96	11–XII	"	201
97	11–XII	"	387
98	11–XII	"	167
99	11–XII	"	619
100	11–XII	"	559
Maximum	———	———	1836
Minimum	———	———	4
Average	———	———	439.4

TABLE 6

Monthly weather observations[a]

MONTHS	TEMPERATURE			HUMIDITY	RAINFALL
	Max.	Min.	Mean		
1925	°C.	°C.	°C.	*per cent*	*mm.*
August	29.2	23.3	26.2	79.0	417.6
September	28.6	22.8	25.7	79.0	183.3
October	28.0	22.4	25.2	81.6	386.3
November	27.9	22.8	25.3	77.0	147.9
December	26.7	21.4	24.0	75.0	71.9
1926					
January	27.2	21.5	24.3	75.3	43.8
February	27.9	21.4	24.7	76.0	5.9
March	31.4	22.0	26.7	77.8	11.2
April	33.3	23.6	28.5	75.2	00.0
May	33.5	23.6	28.5	76.2	55.3
June	30.3	24.3	27.3	80.9	85.0
July	26.7	24.2	25.4	85.2	291.6
August	26.4	23.8	25.1	78.8	270.8
September	29.1	23.7	26.5	79.7	217.0
October	29.9	24.1	27.0	79.2	123.3
November	28.8	23.8	26.3	79.0	186.1
December	29.1	23.3	26.2	79.6	61.5

[a] Compiled from the records of the Department of Plant Physiology.

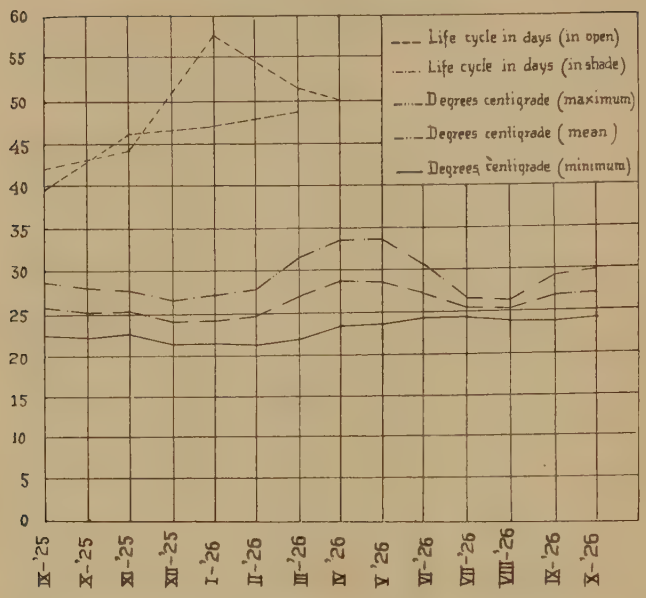

Chart 1.—Relation of length of life cycle to temperature variations (based on tables 6, 7a, and 7b).

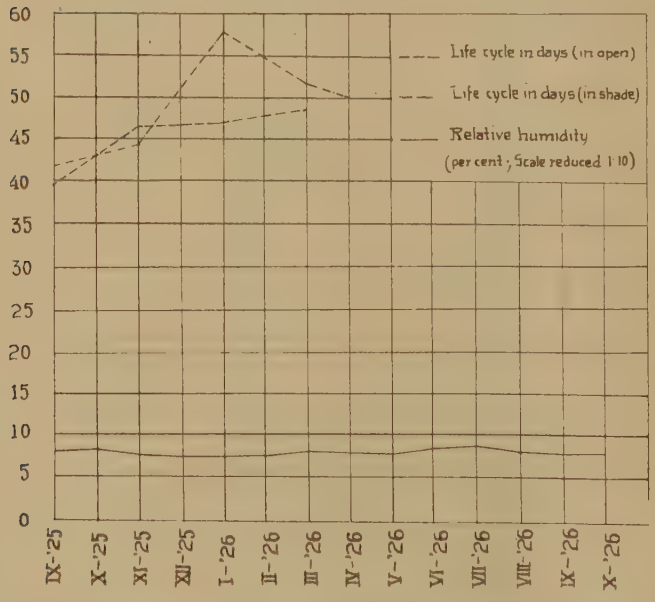

Chart 2.—Relation of length of life cycle to relative humidity (based on tables 6, 7a, and 7b).

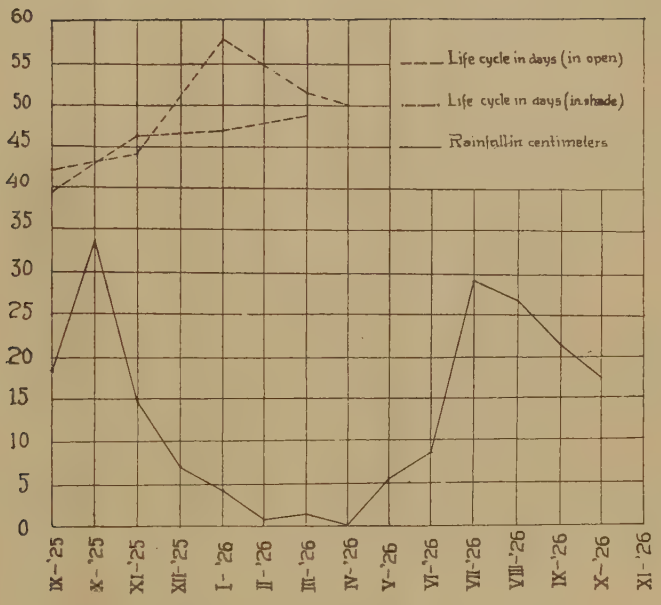

Chart 3.—Relation of length of life cycle to rainfall (based on tables 6, 7a, and 7b).

TABLE 7a

Number of generations in shade in one year

	LOTS				AVERAGE LENGTH OF LIFE CYCLE
	I	II	III	IV	
	1925	1925	1925	1925	*days*
			First generation		
Eggs laid	7–IX	7–IX	7–IX	7–IX	
Eggs hatched	23–IX	23–IX	23–IX	23–IX	
Adult emerged	11–X	11–X	12–X	11–X	42.0
Eggs laid	19–X	19–X	19–X	19–X	
Total life cycle	42 days	42 days	42 days	42 days	
			Second generation		
Eggs laid	2–XI	2–XI	3–XI	2–XI	
Adult emerged	19–XI	19–XI	22–XI	22–XI	44.2
Eggs laid	2–XII	2–XII	3–XII	2–XII	
Total life cycle	44 days	44 days	45 days	44 days	
			Third generation		
Eggs laid	22–XII	23–XII	23–XII	25–XII	
	1926	1926	1926	1926	
Adults emerged	16–I	28–I	29–I	24–I	
Eggs laid	23–I	30–I	30–I	2–II	57.7
Total life cycle	52 days	59 days	58 days	62 days	
			Fourth generation		
Eggs laid	7–II	12–II	13–II	14–II	
Adults emerged	28–II	29–II	4–III	7–III	51.7
Eggs laid	18–III	23–III	22–III	24–III	
Total life cycle	54 days	52 days	51 days	50 days	
			Fifth generation		
Eggs laid	5–IV	6–IV	6–IV	6–IV	
Adults emerged	3–V	2–V	1–V	3–V	50.0
Eggs laid	9–V	10–V	12–V	12–V	
Total life cycle	52 days	48 days	51 days	49 days	
			Sixth generation		
Egg laid	24–V	25–V	Not hatched	26–V	
Adults emerged	15–VI	14–VI	——	All	
	No eggs laid (died)			female died	

TABLE 7b

Number of generations in the open in one year

	LOTS		AVERAGE LENGTH OF LIFE CYCLE
	I	II	
	1925	1925	*days*
	First generation		
Eggs laid	7–IX	6–IX	
Eggs hatched	23–IX	18–IX	
Adults emerged	11–X	10–X	39.5
Eggs laid	19–X	13–X	
Total life cycle	42 days	37 days	
	Second generation		
Eggs laid	3–XI	19–X	
Adults emerged	20–XI	20–XI	46.5
Eggs laid	1–XII	2–XII	
Total life cycle	43 days	50 days	
	Third generation		
Eggs laid	12–XII	15–XII	
Adults emerged	29–XII	30–XII	
	1926	1926	
Eggs laid	20–I	15–I	47.0
Total life cycle	50 days	44 days	
	Fourth generation		
Eggs laid	3–II	28–I	
Adults emerged	4–III	28–II	48.5
Eggs laid	9–III	5–III	
Total life cycle	48 days	49 days	
	Fifth generation		
Eggs laid	27–III	26–III	
Adults emerged	12–IV	all died	
	all died		

TABLE 8

Degree of parasitism

EXPERIMENT NO.	DATE	TOTAL NUMBER OF EGGS IN LOT	PARASITIZED EGGS	PERCENTAGE OF PARASITISM
	1926			
1	30–XI	71	24	33.80
2	30–XI	103	49	47.57
3	30–XI	29	10	34.48
4	30–XI	36	15	41.66
5	30–XI	56	20	35.71
6	30–XI	19	8	42.10
7	30–XI	25	8	32.00
8	30–XI	22	6	27.27
9	30–XI	17	7	41.17
10	30–XI	21	5	23.80
11	30–XI	15	6	40.00
12	30–XI	30	15	50.00
13	30–XI	17	7	41.17
14	30–XI	15	7	46.66
15	30–XI	18	6	33.33
16	30–XI	28	5	17.86
17	30–XI	21	6	28.57
18	30–XI	19	11	57.89
19	30–XI	14	5	35.71
20	30–XI	47	19	40.42
21	30–XI	31	8	25.80
22	30–XI	75	26	34.66
23	30–XI	46	18	39.13
24	30–XI	63	16	25.39
25	30–XI	64	23	35.93
26	5–XII	176	92	52.27
27	5–XII	98	67	68.36
28	5–XII	103	49	47.57
29	5–XII	127	93	73.22
30	5–XII	176	144	81.81
31	5–XII	298	189	63.42
32	5–XII	273	204	74.12
33	5–XII	326	239	73.31
34	6–XII	238	184	77.31
35	6–XII	96	92	95.83
36	6–XII	73	72	98.63
37	6–XII	219	203	92.69
38	6–XII	346	328	94.79
39	6–XII	123	98	79.67
40	6–XII	362	314	86.74
41	9–XII	76	45	59.21
42	9–XII	129	54	41.86
43	10–XII	89	53	59.55
44	10–XII	74	41	55.40
45	10–XII	57	32	56.14
46	10–XII	68	38	55.88
47	10–XII	113	66	58.40
48	10–XII	109	37	33.94
49	10–XII	52	27	51.92
50	10–XII	50	28	56.00
Maximum	———	362	328	98.63
Minimum	———	14	5	17.86
Average	———	95.06	62.38	52.01

TABLE 9

Seasonal occurrence of Perkinsiella vastatrix[a]

LOCALITY	DATE	ABUNDANCE OR SCARCITY OF PEST	APPROXIMATE AGE OF PLANTS	REMARKS
	1925		*months*	
Experiment Station College of Agriculture	VII	Scarce	3	Plants young and apparently healthy.
	VIII	Scarce	4	
	IX	Abundant	5	
	X	Abundant	6	Plant canes preferred by pest to ratoons.
	XI	Abundant	7	
	XII	Abundant	8	
	1926			
	I	Abundant	9	Yellowish leaves burned to rattoon in April.
	II	Scarce	10	
	28–III to 5–IX	None	None	
	25–X	Scarce		Stunted growth.
	7–XI	Abundant	6	Typhoon destroyed canes November 5, 1926.
	14–XI	Abundant	7	Field very grassy.
	21–XI	Abundant	7	
	28–XI	Abundant	7	Stunted yellowish leaves.
	5–XII	Scarce	8	Field very grassy.
	12–XII	Scarce	8	
	19–XII	Scarce	8	
	26–XII	Scarce	8	
	1927			
	2–I	Scarce	9	
	9–I	Scarce	9	
	16–I	Scarce	9	
	1926			
	28–III to 12–IX	None	Rattoon 5	Rattoon of H109 studied from this date until May, when new plantings were made in adjoining lots.
	18–IX	Scarce	5	
	2–X	Abundant	6	
	10–X	Abundant	6	
	16–X	Abundant	6	
Near U. P. Sugar Mill	23–X	Abundant	6	
	31–X	Abundant	6	
	7–XI	Scarce	7	Typhoon of November 5 destroyed canes.
	14–XI	Scarce	7	
	21–XI	Abundant	7	
	5–XII	Abundant	8	
	12–XII	Abundant	8	
	19–XII	Abundant	8	
	26–XII	Scarce	8	
	1927			
	2–I	Scarce	9	
	9–I	Scarce	9	
	16–I	Scarce	9	
	28–III to 31–VIII	None	5	Plant canes growing stunted. Area of field about 2,000 Ha.
	5–IX	Scarce	6	
	12–IX	Scarce	6	Recovering from the effect of hot dry summer.
Putio	18–IX	Scarce	6	

(Paciano Rizal's field)	25–IX	Scarce	6	
	2–X	Scarce	7	
	10–X	Scarce	7	
	16–X	Scarce	7	
	23–X	Scarce	7	
	31–X	Scarce	9	
	7–XI	Scarce	8	Canes destroyed by typhoon November 5, 1926.
	14–XI	Scarce	8	
	21–XI	Scarce	8	
	28–XI	Scarce	8	Recovering from typhoon.
	5–XII	Scarce	9	
	12–XII	Scarce	9	
	19–XII	Scarce	9	
	26–XII	Scarce	9	
	1927			
	2–I	Scarce	10	
	9–I	Scarce	10	
	16–I	Scarce	10	
	28–III to 31–VIII	None		Recovering from stunted growth.
	5–IX	Scarce	6	
	12–IX	Scarce	8	
	12–IX	Abundant	8	
	18–IX	Abundant	8	
Behind Protestant Chapel, College of Agriculture (field of Timoteo Villegas)	25–IX	Abundant	8	
	2–X	Abundant	9	
	10–X	Abundant	9	
	16–X	Abundant	9	
	23–X	Abundant	9	
	31–X	Abundant	9	
	7–XI	Scarce	10	Destroyed by typhoon November 5, 1926.
	14–XI	Scarce	10	
	21–XI	Abundant	10	Recovering.
	28–XI	Abundant	10	Recovered.
	5–XII	Abundant	11	
	12–XII	Scarce	11	
	19–XII	Scarce	11	
	26–XII	Scarce	11	
	1927			
	2–I	Scarce	12 Plant canes	Being harvested.
	28–III to 1–IX	None	7	
	5–IX	Scarce	7	
	12–IX	Abundant	7	
	18–IX	Abundant	7	
	25–IX	Abundant	7	
	2–X	Abundant	8	
Sugar cane fields at Anos	10–X	Abundant	8	
	16–X	Abundant	8	
	23–X	Abundant	8	
	31–X	Abundant	8	
	7–XI	Scarce	9	Destroyed by typhoon November 5, 1926. Leaves dropping.
	14–XI	Scarce	9	
	21–XI	Abundant	9	New leaves developing.
	28–XI	Abundant	9	
	5–XII	Abundant	10	
	12–XII	Abundant	10	
	19–XII	Abundant	10	
	26–XII	Scarce	10	
	1927			
	2–I	Scarce	11	Canes ready for harvest.
	9–I	Scarce	11	
	16–I	Scarce	11	

TABLE 10

Degree of susceptibility of different cane varieties in Los Baños

DATE OF PLANTING	DATE OF LAST OBSERVATION	AGE AT LAST OBSERVATION	LIGHT INFESTATION	MEDIUM INFESTATION	HEAVY INFESTATION	VERY HEAVY INFESTATION
1926	1926	*days*	*variety*	*variety*	*variety*	*variety*
7–I	30–X	296	Uba	Cebu Purple	Pampanga Purple	
7–I	30–X	296	H109	C.A.N. 18156 (Cagayan Striped)	Luzon White	
7–I	30–X	296			Luzon Striped[a]	
7–I	30–X	296			Negros Purple	
2–II	30–X	270	Toledo	Variation of striped Tanna		
2–II	30–X	270	Morado			
2–II	30–X	270	D.I. 52			
15–IV	30–X	198				Pampanga Purple Striped[b]
24–IV	30–X	189		P.B. 158		
28–IV	30–X	185			P.B. 124	
3–V	30–X	180			P.B. 142	
3–V	30–X	180			Java 247	
18–V	30–X	165	C.A.C. 87			
20–V	30–X	163	P.B. 68		P.B. 148	
20–V	30–X	163	P.B. 94			
26–V	30–X	157		P.B. 117[c]		
27–V	30–X	156				Badila
30–V	30–X	153			C.A.N. 18158 (Cagayan Purple)	
8–VI	30–X	144			Negros Purple Seedlings	
15–VI	30–X	137			P.B. 119[a]	
9–VII	30–X	113			C.A.N. 18159 (Cagayan White)	
7–VIII	30–X	84			Seedlings of P.B. 121	

[a] Bud sport of Luzon White.

[b] Bud sport of Pampanga Purple.

[c] Seedlings of Badila.

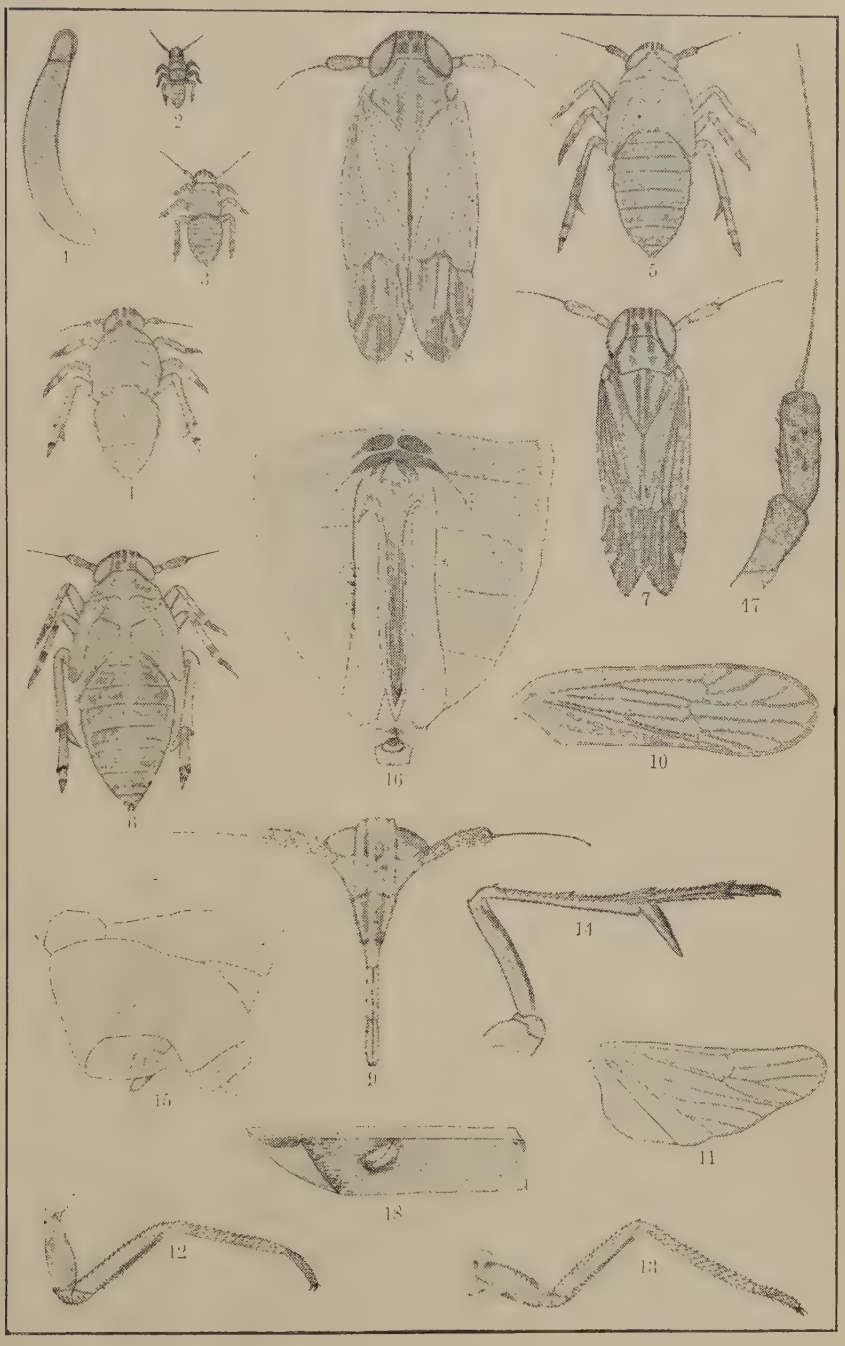

PLATE I

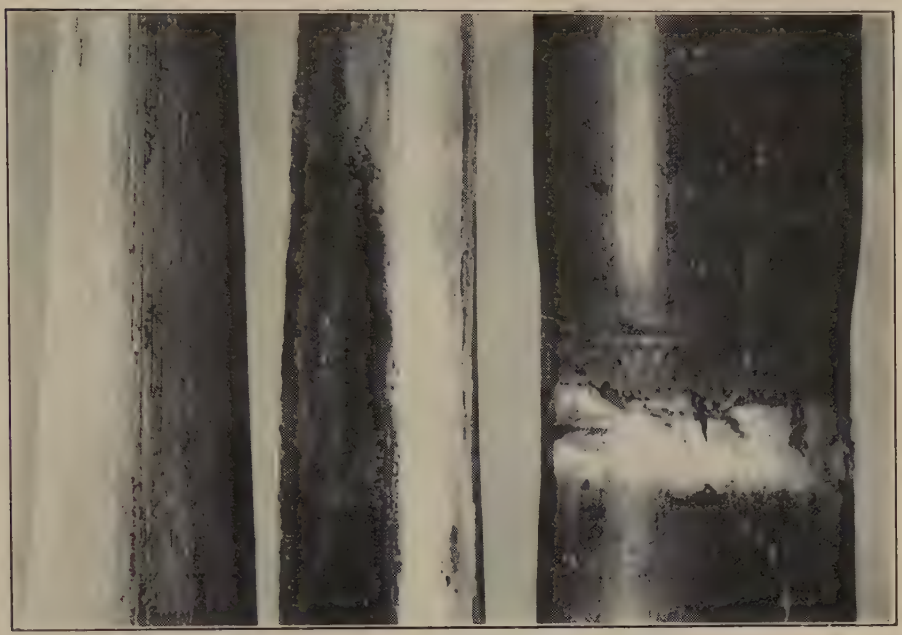

Fig. 1

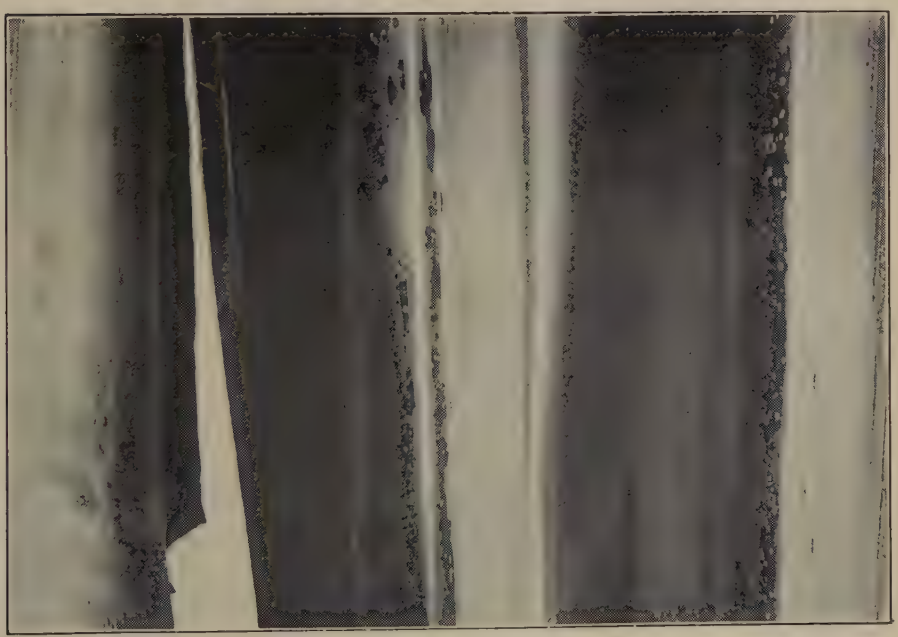

Fig. 2

PLATE II

THE POSSIBILITIES OF CASSAVA PRODUCTION IN THE PHILIPPINES[1]

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Of the Department of Agricultural Chemistry

As it grows wild in many sections in the Islands, most Filipinos are acquainted with camoteng cahoy, (*Manihot utilissima*), also known as cassava and manioc. Perhaps their first acquaintance with this plant was in childhood through the classical *suman* made from its flour. As familiarity breeds contempt, so we consider this plant good only as a famine crop and for making sweetmeats and confectionery for special occasions. Lately, however, our attention has been attracted to cassava on account of our large importation of starch from China, the British and Dutch East Indies, and the United States. To give an idea of the amount of these importations, the following figures from the 1923 and 1925 Statistical Bulletins of the Bureau of Commerce and Industry and the 1926 Annual Report of the Insular Collector of Customs are quoted:

TABLE 1

Value in pesos of starch importation into the Philippines

YEAR	BRITISH EAST INDIES	CHINA	DUTCH EAST INDIES	UNITED STATES	TOTAL
1920	36,287	44,614	42,980	———	123,881
1921	15,488	273,285	29,504	———	318,277
1922	21,818	297,947	142,504	———	461,858
1923	53,756	215,503	289,324	———	558,583
1924	6,763	101,416	462,568	———	570,747
1925	6,394	63,552	426,306	40,985	540,237
1926	7,555	59,322	470,491	53,457	590,825

The greater part of this starch is sold for laundry use under the name of *gaw-gaw*. Table 1 shows that since 1920 our importation of this product has increased yearly until in 1926 starch worth over ₱590,000 was imported.

Considering the nature of the plant and its cultivation, is there any reason that our supply should not be grown in our own country? A few statements on cassava cultivation will show that apparently there is none:

1. Cassava is a very easy plant to grow under most field crop conditions in the Philippines.

[1]Experiment Station contribution No. 469. Revised and condensed for publication from an article read by Dr. Manuel L. Roxas in 1925 before the Philippine Society of Technical Agriculturists, at the College of Agriculture, Los Baños, P. I.

2. There is an exact parallel between the planting and cultivation of sugar cane and cassava. Both produce after one year. Both are propagated by cuttings. Both produce a carbohydrate.

3. Cassava has many advantages over sugar cane which few people seem to realize. In the first place, cassava may be propagated more rapidly than sugar cane as more cuttings can be made from the stem than from the sugar cane plant, since cassava cuttings are obtained from the base up, while in sugar cane usually only the top is used. In the second place, the machinery for the manufacture of starch is a great deal simpler than that used in making sugar. The cassava manufacturing season may be extended throughout the year while with sugar cane this practice is possible only in limited regions. The present price of starch is higher than that of raw sugar and the yield to the hectare with the best variety of cassava is also greater than that of sugar cane. With sugar cane the yield to the hectare from fertile lands in Luzon is around five tons of sugar, while with cassava between six and seven tons of starch may be produced. The margin of profit from cassava is thus wider than that from sugar cane.

4. Because of the simplicity of the machinery required in cassava starch manufacture, which makes it possible to operate on a comparatively small capital, cassava may be grown profitably on a small as well as on a large scale and may be safely produced on a much narrower profit than sugar cane.

5. Local demand for cassava exists. This may be greatly extended as it is used both for food and in laundry work. As an export product it has possibilities for industrial purposes in glue manufacture, in sizing paper, and in cotton mills.

A by-product from the starch manufacture consisting of fibrous and protein material and unextracted starch may be used for animal feed of high calorific value—good for fattening hogs and other domestic animals. This by-product will add to the profit in starch manufacture.

Fancy food products, such as cassava pearl, table syrup, confectionery flour, may be produced for local consumption, thus helping to increase the use of the plant.

6. Cassava may be a cheaper source of starch than corn, as shown by figures furnished by the Department of Agronomy. The average production of shelled corn per hectare in the Philippines is 0.819 tons and in the Corn Belt of the United States, 2.514 tons. Assuming that there is 70 per cent starch in corn, these figures will give in the Philippines 0.573 tons of starch and in the United States, 1.800 tons.

The yield of starch from cassava is about six tons per hectare and it is manufactured in a much simpler way than corn starch is.

As our products enter the United States free, we may be able to invade American markets with starch that can undersell their corn product. The yearly production of starch producing plants (excluding wheat) in the

United States and Europe shows that the starch market of the United States and Europe is worth considering.

Production of potatoes in U. S.	*Value*
1921—361,659,000 bushels	$398,362,000
1922—453,396,000 bushels	263,355,000
1923—412,392,000 bushels	339,322,000
1924—454,784,000 bushels	292,481,000

Sweet potatoes	*Value*
1921— 98,654,000 bushels	$86,894,000
1922—109,394,000 bushels	84,295,000
1923— 97,177,000 bushels	95,091,000
1924— 71,861,000 bushels	92,290,000

Corn production in U. S.	*Value*
1921—3,068,569,000 bushels	$1,297,213,000
1922—2,906,020,000 bushels	1,910,775,000
1923—3,054,395,000 bushels	2,217,229,000
1924—2,436,513,000 bushels	2,405,468,000

Corn production in Europe
1921—298,802,000 bushels
1922—304,640,000 bushels
1923—385,357,000 bushels
1924—521,293,000 bushels

7. Cassava is not a permanent crop, so that in case of over-production a farmer can easily turn to other crops such as sugar cane and rice. Thousands of hectares of cassava land will be needed to supply the local demand for starch, and since we import practically all we are using, the production for the home consumption offers sufficient incentive for its cultivation in the Islands.

Considering these advantages is there any excuse for our importing *gaw-gaw?*

Some time ago a Filipino senator made the statement in the press that Filipino capital is both "timid and lazy". The first term may also be applied to our agriculturists. We leave the use of the second term to more daring critics. Evidently, there is lack of foresight and initiative among our farmers. Yet we have to have faith in the inherent progressiveness of our farmers and we should find a way to make them see the advantages to be found in some new fields. Their conservativism can be explained by the present make up of our urban societies and an apparent lack of business ethics among some of "the more enlightened," so that under their tactics the younger generation as well as the older usually have become "hard-boiled". Industrial development of this kind devolves on those who have the vision and absolute faith in our power to go ahead with a determination that will not allow failure.

The importation of cassava starch is not the only instance of the importation of products into the Philippines which can be produced here, but in

the case of cassava the advantages of its local production are more apparent than in some other products. With this product, lack of capital can not be invoked, as little is needed.

THE PLANTING AND CULTIVATION OF CASSAVA

It is not yet definitely known what varieties of cassava are best suited for commercial planting for the manufacture of starch. Some investigators recommend Aipin Valenca, Aipin Mangi, Mandioca Basiorao and Mandioca sao Pedro Preto as the best varieties for the purpose. These are high yielding varieties, superior to the native variety Balinghoy. Sison (1921) found that Aipin Valenca, Mandioca Basiorao, and Mandioca sao Pedro Preto are the best for commercial manufacture of starch, while Soliven (1921) in his investigation came to the conclusion that the Mangi variety gave the highest percentage (99.6 per cent) of starch during maturity with Mandioca cassava second with 91.09 per cent and Aipin Valenca third with 84.3 per cent. Foreign varieties growing in the College and planted on the hilly and dry portion of Rizal Province have given poor results.

Any part of the stem of the cassava plant, including the stumps, may be used for propagation, but the best part is the matured portion of the stem, with the exception of the part nearest to the root and the green portion at the upper end.

It has been claimed that the planting of cassava can be done any time of the year provided there is plenty of moisture in the soil. Opinions, however, vary as to the best time for planting. Many believe that planting should be done just before and during the wet months when there is plenty of moisture in the soil, or during the months of May, August, and November for Los Baños. Others are of the opinion that the best planting season is during the months of February and March when there is little rain. At this time the cuttings are able to root, but the weeds are unable to grow when the rain comes in May, and as a result the cassava having had a good start beats the weeds, and less weeding is necessary in the later development of the crop than when planted during the rainy season.

Well-drained sandy loam or rich light soil is recommended as the best for cassava production. Heavier soil requires deeper preparation. Soil where green manure has just grown produces good cassava.

Little cultivation is necessary for maximum production of cassava roots. If planted in February or March two cultivations are enough, the first to cover the furrows, and to be done before the fifth month after planting, while the second is to loosen the soil in between the furrows. It is also believed that during the early life of the plant it should receive shallow and through cultivation, or weed control.

Cassava may be harvested for food six months after planting any time within the year, but for starch manufacture it would be better to defer harvesting until the plant is about twelve months old. The time of matur-

ity, however, depends on the variety. Soliven found in his investigation that the variety Aipin Mangi should be harvested for food when from seven to eleven months old and for starch when from ten and one-half to twelve months old. Aipin Valenca should be harvested for food before it is eleven and one-half months old and for starch any time from ten and one-half to thirteen and one-half months old, while Mandioca cassava should be harvested both for food and starch at the age of from nine to eleven and one-half months.

When the plant reaches maturity and is left unharvested there is a rapid decrease of starch content, as shown in table 2.

TABLE 2

Relation of age and starch content of cassava roots

VARIETY	AGE	PERCENTAGE OF STARCH	VARIETY	AGE	PERCENTAGE OF STARCH
	month	*air-dry basis*		*month*	*air-dry basis*
	10	77.15		10	75.36
	11	78.45		11	75.50
Aipin Mangi	12	87.90	Angular	12	81.00
	13	99.60		13	76.27
	14	73.10		14	59.22
	8	68.50			
	9	76.50			
	10	84.31		10	76.20
Aipin Valenca	11	84.00	White Smooth	11	77.12
	12	84.10	Intermediate	12	79.04
	13	75.05		13	69.00
				14	66.00
				7	70.65
	8	67.66		8	71.60
Mandioca cassava	9	83.16	Red	9	82.50
	10	91.09		10	75.60
	11	86.46		11	70.48
	12	79.00			

The time of harvesting also affects the yield of cassava as shown in the result of the experiment by Sison (see table 3).

It is the general belief that the yield decreases gradually and the roots become fibrous if left unharvested when matured. If the plant is cut and the roots left in the field for ratoon they become watery at first but later become normal as soon as new leaves have grown. There are, however, some who believe that cutting the plant spoils the roots and they later disappear.

The best planting distance is not definitely known, but reliable authorities claim that one meter by 75 centimeters, or one meter by one meter are reasonable. On good soil a distance of 120 centimeters by 150 centimeters is claimed to be the best.

TABLE 3

Effect of time of harvesting on yield of cassava per hectare (10,000 plants to the hectare)

VARIETY	10 MONTHS	11 MONTHS	12 MONTHS
Kapo Colorado	7,140	9,960	10,840
White Smooth Intermediate	8,640	12,360	12,300
Angular	9,280	12,940	13,860
Rough Intermediate	10,640	13,280	14,320
Kapo White	11,260	11,740	15,220
Casjave Singkong Manis	12,980	15,120	16,140
Aipin Valenca	18,320	20,320	20,970
Aipin Mangi	19,200	22,620	35,700
Mandioca Basiorao	36,060	37,780	38,280
Mandioca sao Pedro Preto	27,880	37,180	38,500

Ratooning of cassava may be done for two times or more, but experienced growers believe that it is not an advisable practice owing to the considerable inconvenience it causes to cultivation.

Harvested tubers should be used immediately for they deteriorate very fast, especially if cleaned of adhering soil. In harvesting, it is advisable to remove from the soil only such amounts as can be used on the same or the following day. Stems and cuttings of the stems may be kept for several months without planting them in the soil provided they are kept in a moist shady place and the roots coming from the nodes are allowed to reach the soil. In Java, careful experiments have shown that a planting which was cut twice, first at the age of two and one-half months and second at the age of five and one-half months, gave better yield when harvested at the age of twenty months than that in which no cuttings were made.

THE MANUFACTURE OF STARCH AND FLOUR FROM CASSAVA

Roxas and Manio (1921) carried an experiment on the manufacture of starch and flour from cassava. The experiment was made possible with the use of a cassava grinding machine designed in the College of Agriculture under the direction of Professor Cuzner then of the Department of Rural Engineering. The following is from Roxas and Manio:

> The machine consists essentially of a power-driven cylinder on which is mounted a cylindrical grater, the roots being fed on to the cylinder through a hopper on the top. The grater was made by driving the points of sharp nails through a sheet of galvanized iron. A stream of water plays on this cylinder so as to keep it washed free from grated material. After the material is grated, it falls on to an oscillating sieve which is set at a slight angle so that the fiber which is left after the starch is washed out, falls off the lower end. The starch and water fall through into a trough which has a very slight pitch so that the current is slow, allowing the starch to settle as the water is drawn off.

Calculations of the production cost per kilogram of cassava starch

The average production cost per kilogram air-dry starch as estimated by Manio (1919) from results of two tests with the machine is taken from his calculation as follows:

Capacity of the machine per hour with two laborers	55.2 kgm. of roots
Expenses of the machine, including oil, fuel, interest, and two laborers at 12.5 centavos an hour, etc.	42.5 centavos
Cost per kgm. of roots	77.0 centavos
Estimated yield of roots per hectare	50.00 tons

Operating cost at ₱0.77 per kgm. for 50 tons	₱385.00
Production cost of cassava roots	100.66
Total cost per 50 tons roots	485.66
Yield of starch from 50 tons roots at 24 per cent extraction	12.0 tons
Cost per kgm. starch produced	₱0.0405

To the above cost, a charge estimated at 5 centavos a kilogram of starch should be added for over-head charges; that is, for packing, shipping, depreciation on the implements used, interest on the money invested, advertisement, etc. This would bring the total cost to about 10 centavos per kilogram.

Calculating on a production cost of 10 centavos and a wholesale price of 20 centavos per kilogram or 10 centavos net gain per kilogram of starch, cassava, when raised for starch, would give the farmer a net return of ₱1,200 per hectare. The wholesale price may be cut down to 15 centavos per kilogram and still leave a net profit of ₱600 per hectare which is considered a very good return. When this price is compared with the price of corn starch which is sold in pound packages at 35 centavos a package and *gaw-gaw* at 40 centavos a kilogram, it still leaves a wide margin of profit for the cassava grower.

PREPARATION OF CASSAVA FLOUR

The preparation of cassava flour consists simply of grinding the peeled roots without water and drying the product in the sun or with the aid of artificial heat to a moisture content of about 15 per cent. In this method, cassava flour of about 74.06 per cent starch content will be obtained which can be sold to the manufacturers of glucose or denatured alcohol. The cost of production per kilogram of flour is less than that of starch as the weight obtained from a hectare will be much greater. Assuming the average yield of 50 tons of roots per hectare, the yield of air-dry flour would be 21.77 tons.

The cost of production of cassava flour from 50 tons of roots would be about the same as starch, as the cost for the wash water is not included in the calculations. The cost per kilogram of flour would then be

$$\frac{485.66}{21.77} = 2.22 \text{ centavos.}$$

The same cassava machine used by Roxas and Manio in 1921 was loaned in 1926 to Mr. Leon Katigbak, an *hacendero* of Lipa, Batangas, and from the result of the first trial made with the machine, Mr. Katigbak seems to be very optimistic about the possibilities of his new field of endeavor. A part of his report as published in Volume XVI, No. 2 of THE PHILIPPINE AGRICULTURIST is herewith reproduced:

Judging by conditions under which I made my first trial, it would be worth while to engage in growing this crop by selecting a good variety and securing a fixed market for the product. I am having under careful observation the efficiency of the cassava bagasse obtained from extracting the starch as feed for hogs.

Statement of results of starch extraction and expenses in running the College grater:

Total net weight of the tubers peeled and cleaned	3,800 kgm.
Total net weight of starch obtained	581 kgm.
Total net weight of milled bagasse for hog feed	794 kgm.

Expenses incurred:

For pulling up the tubers in the field	₱ 51.00
For peeling the tubers	38.00
For milling the cassava and collecting the starch and bagasse	18.40
Total expenses	₱107.40

Value of the product:	
581 kgm. of cassava starch at ₱0.20 a kgm.	₱116.20
794 kgm. of cassava bagasse at ₱0.07 a kgm.	55.58
Total	₱171.78
Expenses	107.40
Profit	₱ 64.38

Expenses for fuel in running the motor were not accounted for as the cassava grater as well as the mill for grinding the cassava were run by belting them to the engine of the sugar mill while the milling of the sugar cane was going on. But had a separate motor been used for the cassava machine, the expense for fuel would have run to a little more than a half a centavo per kilogram of peeled and cleaned tubers.

Under proper cultivation, 15,000 kilograms of cleaned and peeled tubers can very well be obtained from a hectare, if a good variety is used. On this basis and using the figures above indicated the value of the crop would be ₱256.20 per hectare.

BRIEF SUGGESTIONS

1. The most important step in starting a cassava plantation is the selection of a high yielding variety, such as Mandioca Basiorao.

2. Plant this variety in well prepared ground; cut the stem every two and a half months and allow the roots to ratoon and plant the cuttings, propagating it rapidly and thus extending the plantation. After five or ten hectares have been planted, the manufacture of starch may be started.

3. At first only a simple machine consisting of a grater and settling tanks and a simple mechanical dryer will be necessary. Later, the plant may be extended to include labor saving devices and a larger machine.

4. A manufacturing plant having a capacity of 2 tons of roots a day can handle 500 tons of roots in 250 days. This quantity can be grown on a plantation of about 20 hectares. Such a plant may be constructed for ₱2500.

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THE RELATION BETWEEN THE TENSILE STRENGTH OF AN ABACA FIBER AND THE LENGTH OF THE INDIVIDUAL CELLS COMPOSING IT[1]

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INTRODUCTION

Abacá is generally considered the best cordage material. Since its value as cordage fiber is mainly dependent upon its tensile strength, a study of this physical property is obviously of great importance.

Review of literature

Espino (1915) determined the tensile strength of the fiber from the edge and middle portion of every leaf sheath of an abacá stalk. He used a very simple apparatus consisting of two iron stands which support a horizontal iron bar. At the middle part of this bar is a clamp which holds the upper end of the fiber to be tested. The determination of the tensile strength was made by continually suspending more weights at the lower end until the fiber broke. He found, among other things, that "contrary, . . . to the common belief, fiber composed of long cells is weaker than that composed of shorter ones."

Espino and Esguerra (1923), Espino and Reyes (1923), Ocampo (1924), Yango (1924), Rivero (1924), Tolentino (1924), Hautea (1924), Ventura (1925), Lopez (1925), Dres (1925), and Gonzalez (1926) determined the tensile strength of the fiber from the edge and middle parts of every leaf sheath in the stalk of fifty-four varieties of abacá. They used practically the same method employed by Espino. Gonzalez summarized the results of all the previous investigators on the subject. He concluded that there is no correlation between the tensile strength of abacá fiber and the length of the cells composing the fiber strand.

The conclusions arrived at by Espino and Gonzalez are contrary to the general idea, as stated by Copeland (1921) and Matthews (1924), that other things being equal, the longer the individual cells composing a fiber, the stronger it should be.

Object of the present study

It was the object of the present study to determine the relation between the tensile strength of an abacá fiber and the length of the individual cells

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composing it, by using a more suitable material and a more accurate apparatus than were used by the investigators named.

Time and place of the present work

This work was conducted in the College of Agriculture, Los Baños, from April 1926 to January 1927.

MATERIALS, METHODS, AND RESULTS

The fiber was obtained from a fruiting stalk of Maguindanao variety. Extraction was made by the use of a native stripping machine. The fibers used in this experiment were obtained from the middle portion of the leaf sheaths. The tensile strength was determined by means of a hand-operated single strand tester, manufactured by Henry L. Scott and Company, Providence, Rhode Island. Good long fiber strands from the sixth, seventh, ninth, and fourteenth leaf sheaths were tested. Every fiber strand was divided into three parts: lower, middle, and upper, each part being separately tested. The number of fiber strands tested for each leaf sheath was from 60 to 75.

The length of the fiber cells from the fiber of the same leaf sheath was also measured with a Bausch and Lomb binocular microscope, using 40 millimeter objectives and 10× eyepieces. Each fiber was divided into three parts—the lower, middle, and upper. The length of 100 cells in each part was measured, so that 300 determinations were made of each fiber.

Separation of the fiber cells was accomplished by macerating the fiber in diluted nitric acid to which a little potassium chlorate had been added. Care was taken not to overcook the fiber.

TABLE 1

Showing the average length of the fiber cells from different portions of the fiber strand in each leaf sheath

POSITION OF LEAF SHEATH	SOURCE OF SAMPLE		
	Lower	Middle	Upper
	mm.	*mm.*	*mm.*
Sixth	3.59±0.020	4.64±0.025	4.11±0.019
Seventh	3.21±0.004	3.85±0.033	3.68±0.024
Ninth	3.18±0.022	4.25±0.019	3.82±0.023
Fourteenth	4.53±0.018	4.61±0.023	3.92±0.018

TABLE 2

Showing average tensile strength of abacá fiber in different portions of leaf sheaths (All data in kilogram per gram meter)

POSITION OF LEAF SHEATH	SOURCE OF SAMPLE		
	Lower	Middle	Upper
Sixth	39.46±0.543	57.90±0.635	44.32±0.511
Seventh	42.11±0.971	56.06±0.688	35.93±0.708
Ninth	37.31±0.596	49.60±0.481	35.47±0.478
Fourteenth	31.95±0.344	32.37±0.380	31.72±0.446

In table 1 are shown the averages of the lengths of the fiber cells from different portions of the fiber strands in each leaf sheath. Table 2 shows the results of the tensile strength determinations. To make the results of the tests comparable, the weights were reduced to kilograms of breaking weight per gram meter. This was computed in the following manner: After every test, each sample which was 25 cm. long was weighed and the weight was multiplied by 4. The breaking weight was then divided by the product and the result is the breaking weight per gram meter.

DISCUSSION OF RESULTS

It has been stated that according to Espino, long-celled fiber is weaker than short-celled. Espino, however, compared fiber strands which were composed of long but thin-walled cells with fiber strands composed of short but thick-walled cells.

Ocampo and Hautea concluded from their study of the tensile strength of fiber from different varieties of abacá that the tensile strength of an abacá fiber strand is not correlated with the length of the cells. Gonzalez after reviewing his own work and that of Espino and Esguerra, Espino and Reyes, Ocampo, Yango, Rivero, Tolentino, Hautea, Ventura, Lopez and Dres, on the length of the individual cells and the tensile strength of the fiber from different varieties of abacá arrived at the same conclusion.

It is evident from these investigations that the materials used were not strictly comparable. The fibers vary in age according to the position in the stalk of the leaf sheath from which they come, and it is well known that the tensile strength of abacá fiber varies with age. Besides, the fibers were from different varieties, a fact which evidently was not taken into consideration.

In the present investigation, the determination of the relation between the tensile strength and the length of the cells composing the strand was made, as previously stated, by dividing the strand into three parts—the lower, middle, and upper. Then the length of the cells and the tensile strength of each portion was determined.

The determinations of the length of 100 individual cells from the lower, from the middle, and from the upper portions showed that the cells from the middle portion are considerably longer than those of the lower and upper portions. The average length of the middle portion may be from 22.63 to 33.81 per cent above the lower portion and 10.11 to 24.12 per cent above the upper portion (table 1).

Determination of the tensile strength shows that the middle portion is considerably stronger than the lower and upper portions (table 2). The average tensile strength of the middle portion of the sixth, seventh, and ninth leaf sheaths is from 24.82 per cent to 31.85 per cent higher than the lower portion and 23.45 per cent to 35.88 per cent higher than the upper portion. In the fourteenth leaf sheath the difference is not significant.

This may be explained by the fact that the fourteenth leaf sheath is still very young; hence the young cells of the fiber are not yet firmly cemented together.

Since the comparison of the tensile strength and the length of the individual cells was made from the same strand, the varietal influence was entirely eliminated.

There remains the influence of age to be considered. From the nature of the growth of abacá, it is obvious that the upper end of a fiber is the oldest part and the lower end, the youngest. To get around the difficulty with respect to age, the fiber was divided, as has been stated, into three portions. The middle portion is younger than the upper and older than the lower portion of a fiber strand. Since the middle portion in all cases has longer cells and higher tensile strength than the lower and upper portions it may be concluded that the difference in the tensile strength in favor of the middle portion is due to the fact that the cells composing it are longer. The general idea that the longer the cells composing a fiber, the stronger it should be, other things being equal, is therefore confirmed.

The above findings may be considered as having considerable economic significance. As has been stated, the value of a fiber for cordage is mainly dependent on its tensile strength. By separating the middle portion, a quantity of abacá fiber having high tensile strength may be obtained. This may be employed for cordage that requires great strength.

SUMMARY AND CONCLUSIONS

1. Some investigators seem to have found that there is no direct correlation between the tensile strength and length of the cells of abacá. This is contrary to the general idea that, other things being equal, the tensile strength of a fiber is directly proportional to the length of the individual cells composing the strand. A close study of the work of these investigators, however, appears to show that they have used materials which are not strictly comparable.

2. In this investigation, the tensile strength of the different portions of single fiber strands of abacá has been studied in connection with the length of the cells composing similar portions.

3. It was found that there exists a direct correlation between the tensile strength and the length of the cells composing a fiber.

4. The fact that the middle portion of an abacá fiber is stronger than the other portions is of considerable practical significance.

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QUADRATURE PARTS OF CONICS

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INTRODUCTION

In a discussion among teachers, the question was once asked if there was a geometric meaning to imaginary values of a variable in an equation: for example, where may we place the point $(o, \pm 3i)$ or the point $(\pm 1, \pm \frac{\sqrt{3}}{2} i)$ of the curve $\frac{x^2}{4} - \frac{y^2}{9} = 1$? We say that such points do not exist. What is the real meaning of the phrase "do not exist"? Does it mean that they do not exist at all, or that they do not exist in the plane in which the equation $\frac{x^2}{4} - \frac{y^2}{9} = 1$ traces a hyperbola?

I tried to answer these questions by the following discussion:

DISCUSSION

Definition. When the (x, y) plane is given and considered to contain ordinary (real) points, the y-quadrature plane will be for points with x ordinary and y in quadrature (imaginary), or the (x, iy) plane, through the x-axis and perpendicular to the y-axis. Similarly, the (ix, y) plane passes through the y-axis and is perpendicular to the x-axis.

Euclidian geometry can not admit of an (ix, iy) plane, a plane that would be perpendicular to the x and y-axes at the same time.

I. $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, is identical with either

$$(a) \quad \frac{x^2}{a^2} - \frac{(iy)^2}{b^2} = 1, \quad x > |a|,$$ a hyperbola in the (x, iy) plane;

$$(b) \quad -\frac{(ix)^2}{a^2} + \frac{y^2}{b^2} = 1, \quad y > |b|,$$ a hyperbola in the (ix, y) plane.

II. $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, is identical with $\frac{x^2}{a^2} + \frac{(iy)^2}{b^2} = 1$, $x > |a|$,

an ellipse in the (x, iy) plane. It is also identical with

$$\frac{(ix)^2}{a^2} + \frac{(iy)^2}{b^2} = 1 \quad \text{which gives}$$

$$y = \pm \frac{b}{a} i \sqrt{(ix)^2 + a^2},$$

a quadrature y for every quadrature value of x, which can not be considered in Euclidian geometry.

III. $y = 4px$ is identical with $(iy)^2 = -4px$, $x < o$ a parabola of the same dimensions, but "oppositely" facing, in the (x, iy).

But $-y^2 = 4p(ix)i$, shows that the first parabola has no "quadrature part" in the plane (ix, y).

IV. The "quadrature parts" of a circle are two equilateral hyperbolas, $x^2 - (iy)^2 = r^2$ and $-(ix)^2 + y^2 = r^2$.

NOTE:—The word "quadrature" was taken from Steinmetz *Engineering Mathematics*: it is a term which I believe is better than "imaginary".

NOTE: A NEW AGRICULTURAL JOURNAL IN INDIA

This new periodical which made its first appearance early this year is the *Journal* issued by the Central Bureau for Animal Husbandry and Dairying in India. As the foreword by Lord Irwin seems to carry some suggestions that may be worth pondering by landholders and other molders of opinion in the Philippines we reprint it from the *Leader* June 2, 1927 (Allahabad, India).

Since the Great War agriculture in England has passed through a period of acute depression. Fluctuating prices and unstable markets have hit farmers badly, and they have been forced to realize that agriculture cannot pay unless it is worked on scientific lines. They are now anxious to take advantage of all that scientific research and experiment can give them, and they are also paying greater attention to the fundamental principles of cattle breeding, cattle-feeding, cattle diseases and dairying, and to the general economics of animal husbandry.

Here in India the same problems confront us as in England, and we must move with the time.

Thanks to the efforts of the Imperial and Provincial departments of Agriculture much is already being done. Cattle-breeding farms have been established, pure-bred herds evolved by selection, and improved bulls supplied for stud purposes to cattle-owners. Successful experiments have been made to increase the milking capacity of cows and continuous efforts are being made to produce sound dual purpose breeds. Courses of instruction in dairying have been instituted, and investigations into the principles underlying stockfeeding have been carried out.

In these ways Government is doing a good deal to improve animal husbandry and dairying, but this is not enough. It is on the big landholders that the country must depend if real progress is to be made.

For the past two centuries England's gentlemen farmers have taken the lead in stock-breeding. They felt that this leadership was a duty they owed both to the farming community and to the State and as a result of their efforts stock breeding has been the mainstay of British agriculture, and England has become the Stud Farm of the World.

Let India's landed aristocracy follow their example.

Scientific cattle-breeding does not ordinarily pay today because it costs more to breed and rear good animals than they are worth when reared, and ready for disposal. But this is because cattle owners are not as yet sufficiently enlightened to pay for pedigree. It is the function of those who can afford it to realize their social obligations and develop cattle im-

provement on scientific lines, even if it does not bring them immediate financial reward. The time will undoubtedly come when sufficient farmers will realize its value and be prepared to pay for it.

At present the tendency of the educated classes is to immerse themselves in politics or the law. These two spheres of action are important and necessary for the constitutional administration of the country, but they are not the vital necessities on which the people of India depend for their very existence from day to day. What is the good of concentrating on strong reins to drive a horse or on rubber-tired wheels to make the carriage comfortable if the horse is so weak that he cannot pull the carriage, or the carriage so frail that it falls to pieces directly anybody sits in it?

Education therefore should be directed into practical channels, and it should be the first aim of all of us to do everything that we can to foster and improve that basic industry of agriculture on which India more perhaps than any other country is dependent.

One of the principal objects of this journal will be to stimulate the interest of Indian landowners in animal husbandry, and to gain their support in building up Indian pedigree herds. I commend this object to everyone who is interested in the material and moral welfare of the people of India, and as head of the administration of this great country, and as one who has always taken a keen and personal interest in all that pertains to agriculture, I wish the journal all success.

Dr. W. A. Orton, of the Tropical Plant Research Foundation, says: The greatest contributions of the tropics in the future will be of sugar, oils and fruits. The principal industry of the tropics will probably continue to be agriculture, but for its fullest development much scientific work will have to be done which is now in its very earliest beginnings. As an example, such important crops as rubber, coffee, and cacao, and most of the tropical fruits, are still propagated from seeds, whereas virtually all the important tree crops of the temperate countries have been for years, sometimes for centuries, carried on as choice grafted stocks and not left to the uncertain chances of seedling growth. Another problem is the apparently paradoxical lack of fresh vegetables on the tropical menu. Whatever may be the cause of this deficiency, medical workers find that part of the lassitude and inefficiency of native laborers is apparently due to lack of necessary vegetable vitamines.

—*Science*—supplement.

Don't wait for great opportunities. Seize common, everyday ones and make them great.

—*The Kalends* (Williams and Wilkins Co.)

EXTENSION DIVISION NOTES

Well-Being and Happiness for the Average Filipino

The following is a set of short rules written by the late Dean Baker as a simple guide for the average Filipino farmer in attaining success in economic independence and in the free exercise of his right of vote to exalt to public office men of his own choosing.

"The whole economic structure of the Philippines rests in the last analysis upon the average farmer. The average farmer is a small landholder or a tenant and his economic condition is granted by all with intimate knowledge of the matter to be usually precarious and financially unsound. What are the most important principles which he must observe in order to attain a reasonable degree of economic independence, of self-sufficiency, of success. We suggest:

1. Avoidance of debt at any sacrifice—rigorous living within income;
2. Cutting out of gambling in all forms;
3. Building up of a small emergency cash reserve;
4. When tenantry yields no betterment and becomes intolerable, then remove at once to a free homestead.
5. Obtaining of maximum returns for unit of land and labor by use of fertilization, seed selection, and better cultivation;
6. Inviolability of voting power and absolute freedom in use of the vote to elect to public office only men of probity who are known to be loyal to the interests of the common man."

C. F. Baker
Dean

Build up a Farm of your Own

In response to Dean Baker's request, the following set of rules was prepared as a supplement to the preceding set.

Everybody takes pride in owning his own house together with the houseyard.

In the same way a farmer takes pride in the farm which he can call his own.

Keeping the house and houseyard properly improved will bring an incalculable profit in the form of comfort and happiness to the family.

In a similar way, keeping the farm improved by proper management, helps to make it yield enough to meet the family's needs and in addition a surplus for a saving.

To realize this ideal, the following suggestions may be made:

1. Own your farm and build your home on it, so that you may attend to your farm work more closely and more economically.

2. If you are working as a tenant, make your tenancy a sure step to farm ownership.

3. If you are working as a farm hand, make it as a sure step to tenancy, or, if possible, to straight farm ownership.

4. At this time—not later—it is much easier in the Philippines than anywhere else to own a farm of 24 hectares (almost free) by applying for a homestead.

5. Save as much as you can out of your farm profits and other earnings in order that you may either buy a farm, or preferably occupy a homestead, and develop it.

6. For any business you may be engaged in, always keep a careful account of your operations, yearly expenses and income.

7. Your business may be called a success when your income is greater than your expenses, for a year or for a number of years—depending upon the nature of your farm enterprise.

8. Make a careful study of the market for your produce as it changes from time to time.

9. Raise on your farm what will bring you the largest amount of profit, and use this as a guide for your system of farm operations.

10. Be ever ready to initiate or join and take a very active part in a community movement tending to make your methods of production and marketing more profitable for your own welfare and that of your community.

INOCENCIO ELAYDA
Director, Extension Service

The Rice Question

The Philippine rice farmer is now facing a situation not known before in this country. That is, a price of rice is lower than has ever been known. At the present price it will no longer pay to produce rice under the existing conditions on our farms. The people are greatly alarmed. Every day the newspapers are filled with items concerning the rice question. Solutions are being sought for the present problem. Many are thinking of a possibility of exporting rice. A petition has been sent to the Acting Governor General asking him to lift the ban on exporting rice which has been in effect since 1919. Mr. Fidel Reyes, Director of the Bureau of Commerce and Industry, has written a very strong letter to the Acting Governor General urging the lifting of the ban.

Opinions, however, differ as regards the possibility of exporting rice. It is believed by some prominent rice dealers that it is quite impossible to export Philippine rice to foreign countries, as China and Japan. It is said that it would be necessary to reduce the price of rice to at least ₱6 a cavan

if it is to be exported to China. Rangoon and Saigon rice sells in the neighboring markets at ₱8 a cavan and considering the cost of transportation and the high tariff duties in Chinese ports it would be quite impossible for Philippine rice to compete at that price. A wealthy rice dealer said that "it needs a very serious study of the situation before we ever attempt to export rice."

In considering the question of exporting rice or in other words of increasing the price of rice, another phase of the question should be considered. While it is true exportation may benefit the rice growers, what about the producers of the coconut, the abacá, the tobacco. They are all rice consumers and if the price of rice goes higher these people will be greatly affected. So that the price of rice must not be increased to an extent that will be detrimental to these crop producers. This was well explained by Senator Juan Alegre in his argument against the lifting of the ban. He stated that at one time rice in the Bicol region sold as high as ₱25 a cavan.

The Bureau of Health prepared a memorandum opposing the lifting of the ban. The memorandum states that the lifting of the ban would tend to decrease the amount of unpolished native rice and increase the importation of polished rice from Saigon. The Bureau claims that the Saigon rice is devoid of vitamins and, when used in the diet to a certain degree, causes beriberi. The memorandum further states that beriberi is third among the diseases in point of prevalence and mortality and that the lifting of the ban in no very long period may make the disease the most dangerous in the Philippines.

Another remedy offered to improve the rice situation, is to decrease production. One of the victims of the low price of rice is a graduate of the College of Agriculture. He is so dissatisfied with the present situation that he is considering growing other crops. He says that there are quite a number of rice farmers in his locality who are contemplating planting sugar cane instead of rice. He, himself, is looking for a place where he can invest in fisheries. He is planning to go to Mindoro where he expects to find the place he wants. He says that if those who are contemplating changing their crop to sugar cane push their plan through it would mean a reduction of rice production and may result in better prices.

The present situation seems very interesting from an economic point of view. The price of rice is very low. People are thinking of exporting rice. But, has the Philippines produced enough rice to feed the whole Filipino people? It has not. We are still importing millions of pesos worth of rice. Millions of sacks of Saigon rice are still coming to Phlippine soil. We have no right to talk of over-production. It has not yet come. The present problem is a problem in agricultural economics. It is a simple economic phenomenon governed by an economic law. There is a break in the economic balance which has resulted in this economic disturbance. Too much of one kind of a commodity has been produced in one region, but

though it could be consumed by the people of the archipelago, it has been impossible to distribute it evenly. Thus the inability of even distribution of the commodity has resulted in the over-stocking in some regions and consequently an abnormally low price. This is the cause of the rice situation.

Other questions may be asked in this connection. Why can foreign rice compete with our rice in our own country in spite of the tariff levied on imported rice? Can it be that there is something wrong with our tariff on rice? Could the consideration of our rice tariff have any bearing on our rice problem? Such questions are worth considering.

EXCHANGE NOTES

More than 800 varieties of rice are growing today at the United States experiment station near Biggs and from this lot Jenkins W. Jones, superintendent, expects to hybridize a rice that will be a heavy yielder and early producer.

The crops of the different varieties are the products of seed brought by Jones from Japan, Korea, China, and India.

Jones is seeking a rice that will head out about August 10 and ripen about September 15, yielding heavily. All of the foreign rice seed is growing under normal Sacramento Valley conditions.

—*Cultivator* (California).

"Until a child is thirteen," reports the American Child Health Association, "a quart of milk a day is vital to complete development."

"According to Canada Public Accounts," writes Arthur Gibson, Dominion Entomologist, in *Scientific Agriculture*, "there was spent on war and demobilization, during the years 1915 to 1926, the sum of $1,694,557,202. During the same period, the losses in Canada from destructive insects amounted to at least $1,375,000,000."

—*The Journal of Agriculture and Horticulture* (Canada).

Figures collected by an appraisal company indicate that a farm building put up in the ordinary way with siding, and left unpainted will last about 20 years, whereas the same building painted every five years will last about 50 years. In the case of the unpainted building if the siding is replaced at the end of 20 years the cost would be about the same as it would have been to paint it every five years. This is not the whole story, however, as the unpainted building at the end of 20 years will have only about 15 per cent of its original value, whereas the painted building at the end of 50

years will have about 20 per cent of its original value. This makes no allowance for the great advantage of good appearance.

—*Prairie Farmer* (Illinois).

The market is deemed but one factor rather than the fundamental cause of poor returns to agriculture. Net income depends upon the quantity of products for sale and the cost of production, as well as the price received. Climate, soil, and equipment affect quantity and quality of the product and cost of production, but the most important factor influencing profits from agriculture is the farmer himself.

—*Experiment Station Record* (U. S. Dept. Agric.).

During recent years in California, where citrus production has been widely studied as a business, the consensus of opinion of many investigators is expressed in a bulletin by R. W. Hodgson. He states that in California experience nitrogen is the only element, and organic matter the only other material which have been demonstrated to give measurable improvements in yield and tree health. He adds that applications of phosphorus and potassium have been made for six years, and no measurable improvement has been noted in certain experiments.

About 200 lb. of nitrogen per acre is the amount recommended for young bearing trees, half of which amount is preferably applied in an organic bulky form, and the remainder in an inorganic or chemical form. For older trees—12 to 20 years old or more—the applications may be increased to 300 lb. of nitrogen per acre.

Such applications of nitrogen will appear tremendously heavy to many growers, especially when it is realised that the following amounts of fertilisers are required to provide 100 lb. only of nitrogen per acre, viz., dried blood, 833 lb.; blood and bone, 2,000 lb.; nitrate of soda, 666 lb.; sulphate of ammonia, 500 lb. Hodgson remarks that it does not appear to matter which of these nitrogenous manures are used. They all appear to give similar results, providing that they are applied in time for the tree's requirements.

—*Agricultural Gazette* (New South Wales).

Fish Chowder can be made with a two-pound piece of any kind of white fish cut into one-inch squares. Measure an equal quantity of potatoes cut into half-inch squares. Fry a scant quarter-pound of salt pork, diced, with a medium-sized onion, thinly sliced, until both are tender, but not brown. Place the above ingredients in alternate layers in a soup kettle, add boiling water to cover generously. Salt and pepper to taste and cook gently for

one-half hour after it begins to boil. Scald one pint of milk and thicken it with two tablespoonfuls of flour blended in a little cold milk. When thick and smooth add to the fish mixture, cover the top with split-and-buttered round crackers and serve. The potatoes will be more tender if parboiled for ten minutes before combining with the fish. To vary this, a pint of tomatoes may take the place of a pint of water, improving the dish for many tastes.

—*Agricultural Society* (Jamaica).

COLLEGE AND ALUMNI NOTES

Mr. José F. Zamora B. Agr. '11, recently elected member of Board of Regents as U. P. Alumni representative, addressed the Student Body Convocation on September 22. Regent Zamora is the first College of Agriculture alumnus—not on College faculty—to address our Student Body.

Mr. Zamora gave many interesting sidelights on the pioneer days in the College. Apparently his College days in spite of tent class rooms and heavy manual labor are treasured happy memories. After the reminiscences, he gave counsel of value on farming as seen by a farmer. Mr. Zamora has made such an outstanding success in farming that he was granted the honorary degree of Master Farmer by the U. P. Hence, he spoke of realities, not theories.

Mr. Gregorio Francisco, B. S. Agr. '17, another of our Master Farmers, was a College visitor for a few days recently. Mr. Francisco is a very successful rice farmer in Nueva Ecija.

Mr. Marcelo V. Arnaldo, B. S. A., '27, writes Professor Lopez that he is now employed as Rural Credit Agent of the Bureau of Agriculture with station in Panay. His district comprises the provinces of Iloilo, Antique, Capiz, and Occidental Negros. Mr. Arnaldo majored in rural economics under the advisership of Professor Lopez. His thesis deals with marketing agricultural products in Laguna.

Doctor Research to the Rescue, prepared under the direction of the Department of English, was recently issued in mimeograph as Circular No. 13. This circular, according to title page, "illustrates and presents agricultural problems in dramatic form". The foreword states that "This circular, *Doctor Research to the Rescue*, is issued with the hope that it may be of help in showing farmers where to go for counsel and in showing farmers and others that research work in laboratories in agricultural colleges is not a waste of time and money, but produces results of much practical value".

Six of the nine scenes given in the Circular were presented last January in the College. The dedication of *Doctor Research* by Dean Baker is "To the Students of the Philippines".

Miss Kathleen McGregor Davis, graduate from The Horticultural College, Swanley, Kent, England, who spent a few days at our College last March, writes from London to Professor Yule. We feel parts of the letter are of such wide interest that we quote:

When I arrived in England the country was looking its best and I seemed to look upon it with quite a different pair of eyes and then I began thinking over my trip and I came to the conclusion that of all the wonderful and beautiful places I had visited the Agricultural College at Los Baños was the place most of all that I should like to visit again. I am not saying this just to please but because I really mean it. Those were red letter days for me and if you ever wonder if you have made some one really happy, you need have no doubts whatsoever. I went down to Swanley for Old Students' Week-end and made everyone including members of the Staff so envious by the description of my visit to your College.

I had a long talk with the Principal, Dr. Kate Barratt, and she gave me the enclosed papers to send to you in case they might interest you and I am also sending you an old number of the College Magazine as it contains a letter from an old student who is teaching Horticulture in the United States. I was a Hostess at a Garden Lovers Dinner at the end of June and I did wish so much you could have been there. Among our guests were Dr. Barratt of Swanley and a Mr. Cowley, editor of one of our Gardening papers. The Curator of the Apothecaries Garden, Chelsea, was also there and gave me permits to visit the Garden, which I did. This Garden was started by the Company of Apothecaries in 1673 for the use of those interested in Botany and as a place in which to grow their specimens, and ever since those days it has been a source of great interest to Botanists and it is a great help now-a-days to students who are granted permits for studying there. Philip Miller, who was appointed Head Gardener in 1722, should, I think, be canonized by the American people! In 1732 he sent a packet of cotton seed to that colony in America founded for poor debtors and called after George II—Georgia! and from this seed comes three quarters of the World's cotton. And when I read this I thought of Dean Baker and felt that one day in the Philippines he would be also remembered in some similar way. Linnaeus and Kalm visited the Garden and John Evelyn mentions it in his Diary. Every plant seems to have some interesting association and I spent a wonderful afternoon with the Curator returning home laden with knowledge and specimens. I thought how amused Mr. Juliano would have been to see Ardissias being carefully nourished under glass (we collected them the day we climbed Maquiling) and the Dean had he seen the Water Hyacinths also being carefully cared for!

I was reading an old book on Gardening the other day and found the following which may amuse you—

"Thomas Johnson exhibited in his window the first bunch of bananas seen in London, 1633. They hung from April 10th until the end of June when they were soft and tender and ready to be eaten."

The Mimics made their first appearance this year on the evening of October 1. Under the able direction of Rev. Hugh Bousman, Student Pastor of the Student Union Church, the club presented two one act plays.

The *Cottage on the Moor* by E. E. Smith and D. L. Ireland presents a bit of England in the days of the Roundheads and the Royalists.

Cast of Characters

Old Man	*Nicolas Llanes*
His Grandson	*Loreto Valera*
Royalist Officer	*Felix Villa*
Sergeant of the Roundheads	*Antonio Madarang*
Trooper of the Roundheads	*Miguel de Guzman*

The second play, *Clauses 3 and 4* by Jorge Bocobo, is a lively bit of Filipino life in the present.

Cast of Characters

Mr. Gatdula, Attorney, graduate of an American University	*Constancio Medrana*
Mameng, U. P. Graduate, B.A.	*Manuela Maramba*
Ninay, U. P. Graduate, H.S.T.C.	*Laura Martelino*
Juan Valle, Freshman, College of Agriculture	*Domingo Tugade*
Mr. Merlain, a young dramatist—Nasario Pidlaoan....	*U. P. Graduates—Mameng's suitors*
Dr. Desa, a young doctor—Paulino Ungos.....	
Mr. Quiñon, a young attorney—Alfonso Briones.....	
Ricardo Santillana, a government employee	*Fortunato Basilio*
Reyes, Clerk in the Gatdula Law Office	*Francisco Franada*
Guests	*Misses Mercedes Martelino* and *Maxima Mulimbayan*
Servant	.....

The Tri-College Chorus under the direction of Mrs. Bousman added much to the evening with three College songs: "Hail to our Philippines," "Rah! Rah! Song" and "Wahoo Song," and with two other numbers, "The Rosary" and "The Bells of St. Mary's."

The higher up in life that a man goes the more necessary it becomes that he shall coöperate with other men. Any man's success depends largely upon the efforts of others, and anyone who is not willing to share his success with these others very seldom has much success to share.